

**STANDARDS PRESENTATION
TO
CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

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TITLE 8, DIVISION 1, CHAPTER 4

Subchapter 5. Electrical Safety Orders
Group 2. High-Voltage Electrical Safety Orders
Article 1. Definitions

§2700. Definitions.

The following definitions of frequently used terms shall be accepted as the intended meanings of these terms whenever used in these High-Voltage Electrical Safety Orders.

NOTE: Definitions of other terms used in only one article are included in the front of that article.

Accepted. An installation is “accepted” if it has been inspected and found by a nationally recognized testing laboratory to conform to specified plans or to procedures of applicable codes.

Accessible.

(A) Accessible (as applied to equipment). Admitting close approach because not guarded by locked doors (unless keys are readily available to those requiring access), elevation or other effective means. (See "Readily Accessible.")

~~(Title 24, Part 3, Article 100.)~~

(B) Accessible (as applied to wiring methods). Not permanently closed in by the structure or finish of the building; capable of being removed or exposed without disturbing the building structure, finish, or fixed appurtenance thereto. (See “Concealed” and “Exposed.”)

~~(Title 24, Part 3, Article 100.)~~

(C) Readily Accessible. Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc.

~~(Title 24, Part 3, Article 100.)~~

(D) Safely Accessible. Not exposing persons installing, operating, maintaining, or inspecting electrical apparatus to serious risks of tripping or falling or of coming in contact with energized electrical parts, moving machinery, surfaces or objects operating at high temperatures, or other hazardous equipment.

Aerial Lift. A device used to raise workers to an elevated position.

Ambient Temperature. The temperature of the cooling medium that comes in contact with the device or equipment.

~~Ampacity. Current-carrying capacity of electric conductors expressed in amperes.~~

The current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Apparatus Case. The case (or tank) of electrical apparatus is that part which serves as the container for the principal energized parts and insulating medium.

Armored cable (Type AC). A fabricated assembly of insulated conductors in a flexible metallic enclosure.

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing

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conditions the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases depending upon the askarel type. Atmosphere.

(See Environment, also.)

(A) Contaminated Atmosphere. An atmosphere containing contaminants which tend to impair the effectiveness of electrical insulation.

(B) Corrosive Atmosphere. An atmosphere containing contaminants which react chemically with the parts of an electrical installation so as to impair its electrical conductivity and/or its mechanical strength.

(C) Explosive Atmosphere. (See Article 34.)

(D) Flammable Atmosphere. (See Article 34.)

Authorized Person. A qualified person delegated to perform specific duties under the conditions existing.

Automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature, or mechanical configuration.

Automatic Circuit Recloser. A self-controlled device for automatically interrupting and reclosing an alternating current circuit, with a predetermined sequence of opening and reclosing followed by resetting, hold closed, or lockout operation.

~~(Title 24, Part 3, Article 3-100.)~~

Automatic Opening. (Tripping). The opening of a switching device under predetermined conditions without the intervention of an attendant.

~~(Title 24, Part 3, Article 3-100.)~~

AWG. American Wire Gauge.

Bare Conductor. See Conductor.

Barricade. Physical obstruction such as tapes, screens or cones intended to warn and limit access to a hazardous area.

Barrier. Physical obstruction which is intended to prevent contact with energized lines or equipment.

~~(Title 24, Part 3, Article 3-100.)~~

Basic Impulse Level (BIL). (See Ratings.)

~~(Title 24, Part 3, Article 3-100.)~~

Bonding (Bonded). The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

~~(Title 24, Part 3, Article 100.)~~

Bonding Jumper. A reliable conductor to assure the required electrical conductivity between metal parts required to be electrically connected.

~~(Title 24, Part 3, Article 100.)~~

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Branch Circuit. That portion of a wiring system extending beyond the automatic overcurrent protective device, excluding any thermal cutout or motor running overload protective device that is not approved for short circuit duty.

Building. For the purposes of these Orders, a building is a structure which stands alone or which is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors.

Bus.

(A) Isolated Phase Bus. One in which each phase conductor is enclosed by an individual metal housing separated from adjacent conductor housings by an air space.

(B) Non-Segregated Phase Bus. One in which all phase conductors are in a common metal enclosure without barriers between phases.

(C) Segregated Phase Bus. One in which all phase conductors are in a common metal enclosure but are segregated by barriers between phases.

~~(Title 24, Part 3, Article 3-100.)~~

Bushing. An insulating structure including a through conductor, or providing a passageway for such a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.

~~(Title 24, Part 3, Article 3-100.)~~

BWG. Birmingham Wire Gauge.

Cabinet. An enclosure designed either for surface or flush mounting, and provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

Cablebus. An assembly of insulated conductors with fittings and conductor terminations in a completely enclosed, ventilated, protective metal housing.

Cable, Electrical. A stranded conductor (single-conductor cable) or a combination of conductors insulated from one another (multiple-conductor cable).

~~(Title 24, Part 3, Article 3-100.)~~

Cable Riser. (See Riser.)

Cable Sheath. A protective covering applied to cables.

NOTE: A cable sheath shall be permitted to consist of multiple layers of which one or more is conductive.

~~(Title 24, Part 3, Article 3-100.)~~

Cable Terminations.

(A) Pothead. A device for the electrical and mechanical termination of an insulated electrical cable.

(B) Stress Cone. Cable termination which provides electrical stress relief for an insulated electrical cable.

(C) Terminal Chamber (Conduit Box). A separate compartment on electrical apparatus for terminating insulated electrical cables.

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(D) Wiping Sleeve. A hollow, cylindrical, metal attachment to the tank (or case) or terminal chamber of electrical apparatus which is used for the mechanical termination of lead-sheathed insulated electrical cable.

~~(Title 24, Part 3, Article 3-100.)~~

Cable tray system. A unit or assembly of units or sections and associated fittings forming a rigid structural system used to securely fasten or support cables and raceways. Cable tray systems include ladders, troughs, channels, solid bottom trays, and other similar structures.

Case (Tank). (See Apparatus Case.)

Certified. Equipment is "certified" if it bears a label, tag, or other record of certification that the equipment:

(A) Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner; or

(B) Is of a kind whose production is periodically inspected by a nationally recognized testing laboratory and is accepted by the laboratory as safe for its intended use.

Circuit. A conductor or system of conductors through which an electric current is intended to flow.

Circuit Breaker. (See Switching Devices.)

~~(Title 24, Part 3, Article 100.)~~

Clearance (Authorization). Authorization to enter an area and/or to perform an act restricted to authorized personnel.

Clearing Time. The time elapsing from the beginning of an overcurrent to the final circuit interruption.

~~(Title 24, Part 3, Article 3-100.)~~

Close and Hold. (See Ratings.)

~~(Title 24, Part 3, Article 3-100.)~~

Collector Ring. An assembly of slip rings for transferring electrical energy between a stationary and a rotating member.

~~(Title 24, Part 3, Article 3-100.)~~

Communication Lines. The conductors and their supporting or containing structures which are used for public or private signal or communication service, and which operate at potentials not exceeding 400 volts to ground or 750 volts between any two points of the circuit, and the transmitted power of which does not exceed 150 watts. When operating at less than 150 volts no limit is placed on the capacity of the system.

NOTE: Telephone, telegraph, railroad signal, data, clock, fire, police-alarm, community television antenna, and other systems conforming with the above are included. Lines used for signaling purposes, but not included under the above definition, are considered as supply lines of the same voltage and are to be so run.

Concealed. Rendered inaccessible by enclosures, raceways, structures, the finish of a building, etc.

~~(Title 24, Part 3, Article 3-100.)~~

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Conductor. A wire, cable, or other conducting material suitable for carrying current.

~~(Title 24, Part 3, Article 3-100.)~~

(1) Bare. A conductor having no covering or electrical insulation whatsoever.

(2) Covered. A conductor encased within material of composition or thickness that is not recognized by these Safety Orders as electrical insulation.

(3) Insulated. A conductor encased within material of composition and thickness that is recognized by these Safety Orders as electrical insulation.

Construction. The erection of new wiring and equipment, and the alteration, conversion, and improvement of existing wiring and equipment.

Contactor. A device for repeatedly establishing and interrupting an electric power circuit.

~~(Title 24, Part 3, Article 3-100.)~~

Contaminated. (See Atmosphere.)

Control.

(A) Automatic Control. An arrangement of electrical controls that provides for switching or otherwise controlling or both in an automatic sequence and under predetermined conditions the necessary devices comprising an equipment. These devices thereupon maintain the required character of service and provide adequate protection against all usual operating emergencies.

(B) Manual Control. Control in which the main devices, whether manually or power operated, are controlled by an attendant.

(C) Manual Operation. Operation by hand without using any other source of power.

~~(Title 24, Part 3, Article 3-100.)~~

Controller. A device, or group of devices, which serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

~~(Title 24, Part 3, Article 100.)~~

Corrosive. (See Atmosphere.)

Covered Conductor. See under "Conductor."

Current.

(A) Asymmetrical Current. The combination of the symmetrical and the direct current component of the current.

(B) Available (Prospective) Short Circuit Current (at a given point in a circuit). The maximum current that the power system can deliver through a given circuit point to any negligible impedance short circuit applied at the given point, or at any other point that will cause the highest current to flow through the given point.

(C) Excitation (Magnetizing) Current. The current supplied to unloaded transformers or similar equipment.

(D) Minimum Operating Current (of a relay or fuse). The minimum current that will cause a device to complete its intended operation.

(E) Overcurrent.

~~1. Fault Current (Short Circuit). A current that flows from one conductor to ground or to another conductor owing to an unintended connection (including an arc) between the two.~~

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2. Overload Current. Any current (exclusive of fault current) in excess of rated current. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

(F) Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (See Overcurrent.)

(G) ~~(F)~~ Short-Time Current. (See Ratings.)
Cutout. (See Switching Devices.)

(Title 24, Part 3, Article 100.)

Cutout Box. An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box proper. (See Cabinet.)

Damp Location. See "Environment."

Dead. Free from any electrical connection to a source of potential difference and from electrical charges: Not having a potential difference from that of earth.

Dead-Front. ~~So designed, constructed, and installed that no energized parts are normally exposed on the front.~~ Without live parts exposed to a person on the operating side of the equipment.
(Title 24, Part 3, Article 3-100.)

De-energized. Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

De-energized Parts. ~~Parts which have been previously energized and are now free from any electrical connection to a source of potential difference and from electrical charges.~~

Designated Employee. A qualified person delegated to perform specific duties under the conditions existing.

Device. A unit of an electrical system that is intended to carry but not utilize electric energy.

Dielectric Heating. The heating of a nominally insulating material due to its own dielectric losses when the material is placed in a varying electric field.

Discharge Device. A device intended for the dissipation of the energy stored in a disconnected inductive or capacitive device.

(Title 24, Part 3, Article 3-100.)

Disconnect (Isolator). (See Switching Devices.)

(Title 24, Part 3, Article 3-100.)

Disconnected Position (of a switchgear assembly removable element). That position in which the primary and secondary disconnecting devices of the removable element are separated by a safe distance from the stationary element contacts.

(Title 24, Part 3, Article 3-100.)

Disconnecting Means. (See Switching Devices.)

(Title 24, Part 3, Article 100.)

Division. Unless otherwise designated in this subchapter, the phrase "division" refers to the current Division of Occupational Safety and Health or any of its predecessors including the

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former Division of Industrial Safety or the Division of Occupational Safety and Health Administration. Reference to the former Division of Industrial Safety or Division of Occupational Safety and Health Administration in these orders is meant to refer to their successor, the Division of Occupational Safety and Health, or any subsequent successor agency. Drawout Mounted Device. One having disconnecting devices and in which the removable portion may be removed from the stationary portion without the necessity of unbolting connections or mounting supports.

~~(Title 24, Part 3, Article 3-100.)~~

Dust-Proof. So constructed or protected that dust will not interfere with its successful operation.

~~(Title 24, Part 3, Article 3-100.)~~

Dust-Tight. So constructed that dust will not enter the enclosing case.

~~(Title 24, Part 3, Article 3-100.)~~

Duty.

(A) Continuous. A requirement of service that demands operation at a substantially constant load for an indefinitely long time.

(B) Intermittent. A requirement of service that demands operation for alternate intervals of (1) load and no load; or (2) load and rest; or (3) load, no load and rest.

(C) Periodic. A type of intermittent duty in which the load conditions are regularly recurrent.

(D) Short-Time. A requirement of service that demands operation at a substantially constant load for a short and definitely specified time.

(E) Varying. A requirement of service that demands operation at loads, and for intervals of time, both of which may be subject to wide variation.

~~(Title 24, Part 3, Article 100.)~~

Electric Line Truck. A truck used to transport workers, tools, and material, and to serve as a traveling workshop for electric power line construction and maintenance work. It is sometimes equipped with a boom and auxiliary equipment for setting poles, digging holes, and elevating material or workers.

Electric Supply Lines. Those conductors used to transmit electric energy and their necessary supporting or containing structures. Signal lines of more than 400 volts to ground are always supply lines within the meaning of the rules, and those of less than 400 volts to ground may be considered as supply lines, if so run and operated throughout.

Enclosed. Surrounded by a fence, wall, case, or housing which will prevent persons from accidentally contacting wiring, equipment, or energized parts contained therein.

~~(Title 24, Part 3, Article 100.)~~

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts, or to protect the equipment from physical damage.

~~(Title 24, Part 3, Article 100.)~~

Energized Parts (Live Parts). Parts which are of a potential different from that of the earth, or some conducting body which serves in place of the earth.

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Environment. (See Atmosphere, also.)

(A) Damp Location. Partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

(B) Dry Location. A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of some buildings under construction.

(C) Wet Location. Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as vehicle washing areas, and locations exposed to weather and unprotected.

Equipment. A general term which includes material, fittings, devices, appliances, fixtures, apparatus, and the like, used as part of, or in connection with, an electrical ~~power transmission and distribution system, or communication systems~~ installation.

~~(Title 24, Part 3, Article 100.)~~

Equipment Grounding Conductor. See “Grounding Conductor, Equipment.”

Explosion-Proof Apparatus. Apparatus enclosed in a case which is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

~~(Title 24, Part 3, Article 100.)~~

Exposed (as applied to energized parts). Energized parts that can be inadvertently touched or approached nearer than a safe distance by a person. It is applied to p~~Parts~~ not suitably guarded, isolated, or insulated. (See Accessible and Concealed.)

~~(Title 24, Part 3, Article 100.)~~

Exposed (as applied to wiring methods). On or attached to the surface or behind panels designed to allow access. [See “Accessible (as applied to wiring methods).”]

Exposed (for the purposes of Article 41). Where the circuit is in such a position that in case of failure of supports or insulation, contact with another circuit may result.

Externally Operable. Capable of being operated without exposing the operator to contact with live parts.

Fault. (See Current.)

Feeder. ~~Any conductors of a wiring system between the service equipment, or the generator switchboard of an isolated plant, and the branch-circuit overcurrent device.~~ All circuit conductors between the service equipment, the source of a separate derived system, or other power supply source and the final branch-circuit overcurrent device.

~~(Title 24, Part 3, Article 100.)~~

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function.

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Fuse. An overcurrent protective device with a circuit opening fusible ~~part member that is~~ directly heated and ~~severed destroyed~~ by the passage of overcurrent through it. (NOTE: A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.)

(A) Expulsion Fuse Unit (Expulsion Fuse). A vented fuse unit in which the expulsion effect of gases produced by the arc and lining of the fuseholder, either alone or aided by a spring, extinguishes the arc.

(B) Power Fuse Unit. A vented, non-vented, or controlled vented fuse unit in which the arc is extinguished by being drawn through solid material, granular material, or liquid, either alone or aided by a spring.

1. Vented Power Fuse. A fuse with provision for the escape of arc gases, liquids, or solid particles to the surrounding atmosphere during circuit interruption.

2. Non-Vented Power Fuse. A fuse without intentional provision for the escape of arc gases, liquids, or solid particles to the atmosphere during circuit interruption.

3. Controlled Vented Power Fuse. A fuse with provision for controlling discharge during circuit interruption such that no solid material may be exhausted into the surrounding atmosphere. The discharge gases shall not ignite or damage insulation in the path of the discharge, nor shall these gases propagate a flashover to or between grounded members or conduction members in the path of the discharge when the distance between the vent and such insulation or conduction members conforms to manufacturer's recommendations.

Ground. A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and earth, or to some conducting body which serves in place of the earth.

(A) Ground (Reference). That conducting body, usually earth, to which electric potential is referenced.

~~(Title 24, Part 3, Article 100.)~~

Grounded. Connected to the earth or to some conducting body that serves in place of the earth.

Grounded Conductor. A system or circuit conductor which is intentionally grounded.

~~(Title 24, Part 3, Article 100.)~~

Grounded, Effectively. Intentionally Permanently connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity ampacity that ground fault current which may occur cannot build up to voltages dangerous to personnel to prevent the buildup of voltages that may result in undue hazards to connected equipment or to persons.

~~(Title 24, Part 3, Article 100.)~~

Grounded, Impedance. Connected to ground through a connection in which an impedance has been inserted intentionally.

~~(Title 24, Part 3, Article 3-100.)~~

Grounded, Solidly. Grounded through a grounding connection in which no impedance has been inserted intentionally.

~~(Title 24, Part 3, Article 3-100.)~~

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Grounded System, Impedance. A system which has one conductor or point (usually the mid-tap or neutral point of a transformer or generator windings) connected to the reference ground through an impedance.

~~(Title 24, Part 3, Article 3-100.)~~

Grounded System, Solidly. A system which has one conductor or point (usually the mid-tap or neutral point of a transformer or generator windings) connected to the reference ground with no intentional impedance imposed in the circuit.

~~(Title 24, Part 3, Article 3-100.)~~

~~Grounding Conductor, Electrode. The conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the grounded conductor of the circuit at the service, or at the source of a separately derived system.~~

~~(Title 24, Part 3, Article 100.)~~

Grounding Conductor. A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

~~(Title 24, Part 3, Article 100.)~~

Grounding Conductor, Equipment. The conductor used to connect noncurrent-carrying metal parts of equipment, raceways and other enclosures to the system grounded conductor, the grounding electrode conductor, or both, at the service equipment ~~and/or the grounding electrode conductor~~ or at the source of a separately derived system.

~~(Title 24, Part 3, Article 100.)~~

Grounding Connection (Ground Connection). (See Ground.)

~~(Title 24, Part 3, Article 100.)~~

Grounding Electrode (Ground Electrode). A conductor imbedded in the earth, used for maintaining ground potential on conductors connected to it, and for dissipating into the earth current conducted to it.

~~(Title 24, Part 3, Article 3-100.)~~

Grounding Electrode Conductor. The conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuits at the service equipment or at the source of a separately derived system.

~~Grounding Conductor. A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode.~~

~~(Title 24, Part 3, Article 100.)~~

Grounding Electrode Resistance. The resistance of the grounding electrode to earth.

Grounding Transformer. A transformer intended primarily for providing a neutral point for system grounding purposes.

~~(Title 24, Part 3, Article 3-100.)~~

Group Operation. The essentially simultaneous operation of all poles of a multi-pole switching device by one operating mechanism.

~~(Title 24, Part 3, Article 3-100.)~~

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Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, ~~or~~ casings, barriers, rails, ~~or~~ screens, mats, or platforms ~~intended to remove the likelihood of prevent or impede the approach to a point of danger or contact by~~ intended to remove the likelihood of prevent or impede the approach to a point of danger or contact by of persons or objects ~~to a point of danger.~~

~~(Title 24, Part 3, Article 3-100.)~~

Health care facilities. Buildings or portions of buildings in which medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided.

NOTE: Health care facilities include, but are not limited to, hospitals, nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers, whether permanent or movable.

Heating Equipment. For the purposes of Article 42, the term "heating equipment" includes any equipment used for heating purposes if heat is generated by induction or dielectric methods.

High Voltage. A sustained voltage of more than 600 volts. (See Voltage.)

~~(Title 24, Part 3, Article 3-100.)~~

High-Voltage System. Associated electrical conductors and equipment operating at or intended to operate at a sustained voltage of more than 600 volts between conductors.

~~(Title 24, Part 3, Article 3-100.)~~

Hook Stick. (See Switch Stick.)

Hot Tools and Ropes. Tools and ropes which are especially designed for work on energized high voltage lines and equipment. Insulated aerial equipment especially designed for work on energized high voltage lines and equipment shall be considered hot line.

Identified (as applied to equipment). Approved as suitable for the specific purpose, function, use, environment, or application, where described in a particular requirement.

NOTE: Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a nationally recognized testing laboratory (through listing and labeling), inspection agency, or other organization recognized under the definition of "acceptable."

Indoor. Indoor, as an adjective, describes a device or equipment which, because of its construction, must be protected from the weather, or be installed in a location which is protected from the weather.

~~(Title 24, Part 3, Article 3-100.)~~

Induction Heating. The heating of a nominally conductive material due to its own I^2R losses when the material is placed in a varying electromagnetic ~~held~~ field.

Insulated. Separated from other conducting surfaces by a dielectric substance (including air space) offering a high resistance to the passage of current.

NOTE: When any object is said to be insulated, it is understood to be insulated in suitable manner for the conditions to which it is subjected. Otherwise, it is within the purpose of these orders, uninsulated. Insulating covering of conductors is one means of making the conductor insulated.

~~(Title 24, Part 3, Article 3-100.)~~

Insulated Conductor. See Conductor, Insulated.

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Insulation (As applied to Cable). That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground.

~~(Title 24, Part 3, Article 3-100.)~~

Interlock. An electrical, mechanical, or key-locked device intended to prevent an undesired sequence of operations.

~~(Title 24, Part 3, Article 3-100.)~~

Interrupter Switch. (See Switching Devices.)

~~(Title 24, Part 3, Article 100.)~~

Interrupting Rating. (See Ratings.)

~~(Title 24, Part 3, Article 3-100.)~~

Isolated (as applied to location). Not readily accessible to persons unless special means ~~for~~ of access are used.

Isolated Power System. A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors.

Junction Box. (See Pull Box.)

~~(Title 24, Part 3, Article 3-100.)~~

Labeled. Equipment is "labeled" if there is attached to it a label, symbol, or other identifying mark of a nationally recognized testing laboratory:

(1) That makes periodic inspections of the production of such equipment, and

(2) Whose labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

Lanyard. A flexible line to secure a wearer of a safety belt or harness to a drop line, lifeline, or fixed anchorage.

Line Clearance Tree Trimming Operations. Operations which include the pruning, trimming, repairing, maintaining, chemical treatment, ~~or removal~~ or clearing of trees, or cutting of brush and miscellaneous vegetation, ~~performed in the vicinity of exposed energized overhead conductors and equipment~~ that is within 10 ft. (305 cm) of electric supply lines and equipment.

Linemen's Body Belt. A leather or web (cotton or nylon) belt designed specifically for employees working on poles or structures. It consists of a waist belt, generally cushioned, with a front buckle, two D rings for attaching safety straps and a multiple-looped strap for holding rings, snaphooks, holsters and other tool holding devices.

Listed. Equipment is "listed" if it is of a kind mentioned in a list that:

(1) Is published by a nationally recognized laboratory that makes periodic inspection of the production of such equipment, and

(2) States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

Live Parts. Energized conductive components.

Location. (See Environment.)

Magnetizing Current. (See Current--Excitation.)

Main Switch. (See Service Entrance Switch.)

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~~(Title 24, Part 3, Article 3-100.)~~

Make and Latch (or Close and Hold) Rating. (See Ratings.)

~~(Title 24, Part 3, Article 3-100.)~~

Manhole. A chamber, in an underground system, containing working space large enough for a person to enter, which provides space and access for installation and maintenance of cables, transformers, or other equipment or apparatus.

~~(Title 24, Part 3, Article 3-100.)~~

Manhole Chimney. A vertical passageway for workers or equipment between the roof of the manhole and the surface (street) level.

~~(Title 24, Part 3, Article 3-100.)~~

Manual Control. (See Control.)

~~(Title 24, Part 3, Article 3-100.)~~

Manual Operation. (See Control.)

~~(Title 24, Part 3, Article 3-100.)~~

Maximum Voltage. (See Ratings.)

~~(Title 24, Part 3, Article 3-100.)~~

Medium Voltage Cable (Type MV). A single or multiconductor solid dielectric insulated cable rated 2001 volts or higher.

Metal-Clad Cable (Type MC). ~~A fabricated assembly of insulated conductor(s) in a flexible metallic enclosure.~~ A factory assembly of one or more insulated circuit conductors with or without optical fiber members enclosed in an armor of interlocking metal tape, or a smooth or corrugated metallic sheath.

~~(Title 24, Part 3, Article 3-100.)~~

Metal-Enclosed. Metal-enclosed, as an adjective, refers to electrical apparatus surrounded by a metal case or housing, usually grounded.

~~(Title 24, Part 3, Article 3-100.)~~

Minimum Bending Radius. The minimum recommended radius to which a conduit or an insulated cable may be bent, measured from its inner surface.

~~(Title 24, Part 3, Article 3-100.)~~

Minimum Operating Current. (See Current.)

Multiple Fuse. An assembly of two or more single-pole fuses.

Nominal System Voltage. (See Voltage.)

~~(Title 24, Part 3, Article 100.)~~

Nonpropagating Liquid. A liquid which, when subjected to a source of ignition, may burn but the flame will not spread from the source of ignition.

Oil (Filled) Cutout. (See Switching Devices.)

~~(Title 24, Part 3, Article 100.)~~

Open Wiring. Uninsulated conductors or insulated conductors without grounded metallic sheaths or shields installed above ground, but not inside apparatus or wiring enclosures.

~~(Title 24, Part 3, Article 3-100.)~~

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Outdoor. Outdoor, as an adjective, describes a device or equipment of weatherproof construction, or a location exposed to the weather.

~~(Title 24, Part 3, Article 3-100.)~~

Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Outline Lighting. An arrangement of incandescent lamps or electric discharge lighting to outline or call attention to certain features, such as the shape of a building or the decoration of a window.

Overcurrent. (See Current.)

Overload. (See Current.)

Overtemperature Protective Device. (See Thermal Protector.)

~~(Title 24, Part 3, Article 3-100.)~~

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front. (See "Switchboard.")

Portable or Mobile Equipment. Electrical equipment mounted on skids, pads, legs, or vehicles, and capable of being moved to any required location.

Pothead. (See Cable Terminations.)

~~(Title 24, Part 3, Article 3-100.)~~

Power and Control Tray Cable (Type TC). A factory assembly of two or more insulated conductors, with or without associated bare or covered grounding conductors under a nonmetallic sheath, approved for installation in cable trays, in raceways, or where supported by a messenger wire.

Power Fuse. (See Fuse.)

Power-Limited Tray Cable (Type PLTC). A factory assembly of two or more insulated conductors under a nonmetallic jacket.

Premises Wiring. (Premises wiring system.) The interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all of their associated hardware, fittings, and wiring devices, both permanently and temporarily installed, that extends from the service point of utility conductors or source of power (such as a battery, a solar photovoltaic system, or a generator, transformer, or converter) to the outlets. Such wiring does not include wiring internal to appliances, fixtures, motors, controllers, motor control centers, and similar equipment.

Protective Device. A device or combination of devices capable of detecting and automatically interrupting a specific condition.

~~(Title 24, Part 3, Article 3-100.)~~

Pull Box. A box with a blank cover into which workers may reach but not enter which is inserted in one or more runs of raceway to facilitate pulling, joining, supporting, or inspecting conductors. The term "pull box" includes but is not limited to: junction boxes, splice boxes, conductor support boxes, inspection boxes, and handholes.

~~(Title 24, Part 3, Article 3-100.)~~

Pulling Tension. The longitudinal force exerted on a cable during installation.

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Qualified Electrical Worker. A qualified person who by reason of a minimum of two years of training and experience with high-voltage circuits and equipment and who has demonstrated by performance familiarity with the work to be performed and the hazards involved.

Qualified Line Clearance Tree Trimmer. A person who has completed a minimum of 18 months-related training and on-the-job experience and is familiar with the special techniques and hazards involved in line clearance tree trimming operations.

Qualified Line Clearance Tree Trimmer Trainee. Any worker regularly assigned to a line clearance tree trimming crew and undergoing on-the-job training who, in the course of such training, has demonstrated the ability to perform the assigned duties safely at that level of training.

Qualified Person. A person who by reason of experience or instruction is familiar with the operation to be performed and the hazards involved.

Raceway. ~~Any~~ An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables or bus bars, which is designed expressly for, and used solely for, this purpose, with additional functions as permitted in this standard.

~~NOTE: Raceways shall be permitted to be of metal or insulating material and the term includes rigid metal conduit, rigid nonmetallic conduit, flexible metal conduit, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface metal raceways, structural raceways, wireways and busways.~~

Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical metallic tubing, electrical nonmetallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

~~(Title 24, Part 3, Article 100.)~~

Rated. A designated value of an operating characteristic at which other characteristics are measured and specified.

~~(Title 24, Part 3, Article 3-100.)~~

Ratings.

(A) **Basic Impulse Level (BIL).** A reference impulse insulation strength expressed in terms of the crest value of the withstand voltage of a standard full impulse voltage wave.

(B) **Interrupting Rating.** Maximum interrupting capability under specified conditions, expressed in amperes or MVA.

(C) **Make and Latch (Close and Hold) Rating.** The highest RMS current at which the device or equipment is designed to operate.

(D) **Short-Time Current Rating.** The maximum RMS current a device, an assembly, or a bus is designed to carry for a specified short-time interval.

~~(Title 24, Part 3, Article 3-100.)~~

Readily Accessible. (See Accessible.)

~~(Title 24, Part 3, Article 100.)~~

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Regulator Bypass Switch. (See Switching Devices.)

~~(Title 24, Part 3, Article 100.)~~

Release Free (Trip Free). A descriptive term indicating that the opening operation of a switching device can prevail over the closing operation during specified portions of the closing operation.

~~(Title 24, Part 3, Article 3-100.)~~

Remote-Control Circuit. Any electric circuit that controls any other circuit through a relay or an equivalent device.

Riser (Cable Riser). A vertical run of insulate cable, associated raceway, and termination.

Safely Accessible. (See Accessible.)

Safety Strap. A web strap designed specifically for use in conjunction with a linemen's body belt to secure the employee to a pole or structure in a manner that permits work with both hands.

Separately Derived System. A premises wiring system whose power is derived from a battery, a solar photovoltaic system, or from a generator, transformer, or converter windings, and that has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Service. The conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

~~(Title 24, Part 3, Article 100.)~~

Service Cable. Service conductors made up in the form of a cable.

Service Conductors. That portion of the supply conductors which extends from the supply main, duct, or from transformers of the serving agency to the service equipment of the premises supplied. For overhead conductors this includes the conductors from the last line pole to the service equipment.

~~(Title 24, Part 3, Article 100.)~~

Service Entrance Conductors. The consumer-owned conductors extending between the service point and the service entrance equipment.

~~(Title 24, Part 3, Article 100.)~~

Service Entrance Switch (Main Switch). The disconnecting means and overcurrent protection installed at or near the service point.

~~(Title 24, Part 3, Article 100.)~~

Service Equipment. The necessary equipment, usually consisting of one or more circuit breakers or switches and fuses, and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and means of cutoff for the supply to a building or structure.

~~(Title 24, Part 3, Article 100.)~~

Service Factor. A multiplier which, applied to the rated output of an electric machine, indicates a permissible loading which may be carried continuously under the conditions for that service factor.

Service Point. The point of connection between the facilities of the serving agency and those of the premises wiring consumer.

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~~(Title 24, Part 3, Article 3-100.)~~

Shielded Cable. A cable in which the insulated conductor(s) is enclosed in a conducting envelope(s), so constructed that substantially every point on the surface of the insulation is at ground potential or at some predetermined potential with respect to ground.

Stored-Energy Operation. Operation by means of energy stored in the mechanism, sufficient to complete a specified operation.

Stress Cone. (See Cable Terminations.)

~~(Title 24, Part 3, Article 3-100.)~~

Submersible. Submersible, as an adjective, describes a device which is so constructed that it will operate satisfactorily when completely or partially submerged in a liquid under specified conditions.

Suitable. Capable of performing with safety the particular function specified in these Orders.

Supervised. Under continuous or intermittent surveillance by a local or remote operator or automatic data processing system.

Switch (Hook) Stick. A device with an insulated handle and a hook or other means for performing stick operation of a switching device.

Switching Device. A device designed to close and/or open one or more an electric circuits.
Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches,
disconnecting means, interrupter switches, and oil (filled) cutouts.

~~(Title 24, Part 3, Article 100.)~~

Switching Devices.

(A) Circuit Breaker. A device designed to open and close a circuit by non-automatic means, and to open the circuit automatically on a predetermined ~~overload of current, without injury to itself when properly applied within its rating.~~ overcurrent without damage to itself when properly applied within its rating.

~~(Title 24, Part 3, Article 100.)~~

(B) Cutout. An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link), or may act as a disconnecting blade by the inclusion of a non-fusible member.

~~(Title 24, Part 3, Article 100.)~~

(C) Disconnecting Means. A device, or group of devices, or other means whereby the conductors of a circuit can be disconnected from their source of supply.

~~(Title 24, Part 3, Article 100.)~~

(D) Disconnecting (or Isolating) Switch (Disconnecter, Isolator). A mechanical switching device used for isolating a circuit or equipment from a source of power. ~~A switch intended for isolating an electric circuit from the source of power.~~ It has no interrupting rating and is intended to be operated only after the circuit has been opened by some other means.

~~(Title 24, Part 3, Article 3-100.)~~

(E) Interrupter Switch. A switch, capable of making, carrying, and interrupting specified currents.

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~~(Title 24, Part 3, Article 100.)~~

(F) Oil Cutout (Oil-Filled Cutout). A cutout in which all or part of the fuse support and its fuse link or disconnecting blades are mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link), so that arc interruption by severing of the fuse link or by opening of the contacts will occur under oil.

~~(Title 24, Part 3, Article 100.)~~

(G) Oil Switch. A switch having contacts which operate under oil (or askarel or other suitable liquid).

~~(Title 24, Part 3, Article 100.)~~

(H) Regulator Bypass Switch. A specific device or combination of devices designed to bypass a regulator.

~~(Title 24, Part 3, Article 100.)~~

Tag. A system or method of identifying circuits, systems or equipment for the purpose of alerting persons that the circuit, system or equipment is being worked on.

Terminal Chamber. (See Cable Terminations.)

~~(Title 24, Part 3, Article 3-100.)~~

Test Position (of a switchgear assembly). That position in which the primary disconnecting devices of the removable element are separated by a safe distance from those in the housing and the secondary disconnecting devices are in operating contact.

~~(Title 24, Part 3, Article 3-100.)~~

Thermal Protector--General. An inherent protective device which is responsive to temperature or current, or both, and which, when properly applied, protects the equipment against overheating due to overload or failure to start.

~~(Title 24, Part 3, Article 3-100.)~~

Transformer Bank. A transformer installation consisting of two or more transformers.

Transformer Installation. An electrical installation consisting of one or more transformers, including associated lead wires and interconnections, which transforms electric energy from one or more alternating current circuits to one or more other alternating current circuits.

Transformer Primary Winding. The winding on the energy input (source) side.

Transformer Secondary Winding. The winding on the energy output (load) side.

Utilization Equipment. Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes.

Vault. A room (including manholes) of fire-resistant construction, primarily used to house electrical equipment.

~~(Title 24, Part 3, Article 3-100.)~~

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors.

Voltage.

(A) Maximum Voltage. (See Ratings.)

~~(Title 24, Part 3, Article 3-100.)~~

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(B) ~~Nominal System Voltage~~. A nominal value assigned to designate a system of a given voltage class.

~~(Title 24, Part 3, Article 3-100.)~~

(C) Voltage (of a circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned.

~~(Title 24, Part 3, Article 100.)~~

NOTE: On various systems such as 3-phase, 4-wire, single phase 3-wire and 3-wire direct current, there may be various circuits of various voltages.

~~(Title 24, Part 3, Article 100.)~~

(D) Voltage to Ground. In grounded circuits the voltage between the given conductor and that point or conductor of the circuit which is grounded; in ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

~~(Title 24, Part 3, Article 100.)~~

Weatherproof. So constructed or protected that exposure to the weather will not interfere with successful operation.

~~(Title 24, Part 3, Article 100.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Subchapter 5. Electrical Safety Orders
Group 2. High-Voltage Electrical Safety Orders
Article 2. Administration

§2706. Application.

(a) These High-Voltage Electrical Safety Orders, apply to all electrical installations and electrical equipment operating or intended to operate on systems of more than 600 volts between conductors and to all work performed directly on or in proximity to such electrical installations, equipment or systems in all places of employment in the State of California as defined in Labor Code Section 6303. These orders do not apply to:

(1) Installations or conductors and equipment in ships, watercraft, railway rolling stock, or aircraft.

(2) Installations of conductors, equipment, and associated enclosures subject to the jurisdiction of the California Public Utilities Commission, that are owned, operated and maintained by an electric, communication or electric railway utility.

EXCEPTION: NO. 1. These orders apply to conduit, vaults, and other like enclosures containing the conductors and equipment of such a utility when located indoors on premises not used exclusively for utility purposes, but do not apply to the utilities conductors and the equipment therein.

EXCEPTION: NO. 2. Article 36, Work and Operating Procedures; and Article 38, Line Clearance Tree Trimming Operations apply to all work performed by electric utilities and electric railways. (~~Title 24, Part 3, Sections 3-089-3 and 3-089-4.~~)

(b) Extent of Application. ~~After the date on which these orders become effective, all installations and equipment shall conform to these orders.~~

~~EXCEPTION: Existing installations and equipment which were in compliance with safety orders, or variances therefrom, in effect prior to the effective date of these safety orders, unless the hazard presented by the installation or equipment is, in the judgment of the Chief of the Division, of such severity as to warrant control by the application of the applicable sections of these orders.~~

(1) Requirements applicable to all installations. The following requirements apply to all electrical installations and utilization equipment, regardless of when they were designed or installed:

Sec. 2710 – Examination, Installation and Use of Equipment.

Sec. 2710.1 – Mounting and Cooling of Equipment.

Sec. 2712 – Atmospheric and Environmental Protection.

Sec. 2714 – Installation and Maintenance.

Sec. 2715(c) – Splices.

Sec. 2716.1 – Arcing Parts.

Sec. 2718 – Marking.

Sec. 2718.1 – Disconnecting Means and Circuits, Except for (e) and (f).

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Sec. 2739.4 – Grounding Connections.

Sec. 2742.0 – Grounding Path.

Sec. 2742.1(b)(1) – (b)(4) – Grounding of Supports, Enclosures and Equipment.

Sec. 2742.2 – Nonelectrical Equipment.

Sec. 2742.3(a) – Methods of Grounding Fixed Equipment.

Article 34, Hazardous (Classified) Locations, Sec. 2925 – General.

(2) Requirements applicable to installations made after March 15, 1972. Every electrical installation and all utilization equipment installed or overhauled after March 15, 1972, shall comply with the provisions of these Safety Orders, except as noted in Sections 2706(b)(3) and (b)(4) of this Article.

(3) Requirements applicable only to installations made after April 16, 1981. The following requirements apply only to electrical installations and utilization equipment installed after April 16, 1981:

Sec. 2743(a) – Grounding of Systems and Circuits.

Sec. 2749.1(b) – Systems over 600 volts, nominal – Aboveground Wiring Methods.

Sec. 2890(c) – Switching.

Sec. 2931 – Entrance and Access to Workspace.

(4) Requirements applicable only to installations made after [Effective date of these Orders]. The following requirements apply only to electrical installations and utilization equipment installed after [Effective date of these Orders]:

Sec. 2718.1(e) – Capable of accepting a lock.

Sec. 2718.1(f) – Marking for series combination ratings.

Sec. 2735(a)(1), (a)(2), and (b)(1) – Overcurrent Protection.

Sec. 2738 – Identification of Multiwire Branch Circuits.

Sec. 2833.1(c)(2) and (c)(3) – Connection of switches.

Sec. 2833.2(b) – Load interrupter switches.

Sec. 2932(e) – Workspace.

Sec. 2946(b)(2) EXCEPTION – Provisions for Preventing Accidents Due to Proximity to Overhead Lines.

(c) Regulations herein which may affect building standards apply to all buildings, or building alteration, or building modification for which construction is commenced after the effective date of the regulations. Date of commencement of construction for the purpose of this section, shall be:

(1) The advertising date for invitation of bids for State and local government projects:

(2) The building construction permit issuance date for other than government projects.

~~(Title 24, Part 3, Section 3-089-14.)~~

(d) For installation requirements not specifically contained herein, installations in compliance with Title 24, Part 3, in effect at the time of construction, will be considered as complying with the intent of these orders.

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(e) Nothing contained in these regulations shall be considered as abrogating the provisions relating to public safety of any ordinance, rule or regulation of any governmental agency, providing such local ordinance, rule or regulation does not lessen the provisions for safety contained in these regulations.

(f) These orders take precedence over any other orders in the California Administrative Code, Title 8, relating to high-voltage facilities or work procedures that are inconsistent with them.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2707. Approvals.

(a) Approved means acceptable to the Division of Occupational Safety and Health which has the responsibility and authority to grant the approval for the specified condition or application.

(b) An installation or equipment is acceptable to the Division of Occupational Safety and Health, and approved within the meaning of these Safety Orders:

(1) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory recognized pursuant to 29 CFR Sec. 1910.7; or

(2) With respect to an installation or equipment of a kind that no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, the Division of Occupational Safety and Health will approve materials, devices, appliances, installations, arrangement or methods of construction intended for use under these orders, provided necessary safety requirements are met for quality, strength, effectiveness, fire resistance, durability, and the protection of life and health.

~~(Title 24, Part 3, Section 110 2.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Subchapter 5. Electrical Safety Orders
Group 2. High-Voltage Electrical Safety Orders
Article 3. General

§2710. Mounting Requirements. Examination, Installation, and Use of Equipment.

~~Electrical apparatus and equipment shall be firmly secured to surfaces upon which it is mounted.~~

(a) Examination. Electric equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined using the following considerations:

(1) Suitability for installation and use in conformity with the provisions of these Orders;

NOTE to subsection (a)(1): Suitability of equipment for an identified purpose may be evidenced by listing or labeling for that identified purpose.

(2) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided;

(3) Wire-bending and connection space;

(4) Electrical insulation;

(5) Heating effects under all conditions of use;

(6) Arcing effects;

(7) Classification by type, size, voltage, current capacity, and specific use; and

(8) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment.

(b) Installation and use. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

(c) Insulation integrity. Completed wiring installations shall be free from short circuits and from grounds other than those required or permitted by these Safety Orders.

(d) Interrupting rating.

(1) Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment.

(2) Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

(e) Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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§2710.1. Mounting and Cooling of Equipment.

(a) Mounting. Electrical apparatus and equipment shall be firmly secured to surfaces upon which it is mounted.

NOTE: Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials are not considered secure means of fastening electric equipment.

(b) Cooling.

(1) Electric equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air.

(2) Electric equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2712. Atmospheric and Environmental Protection.

(a) Electrical installations and equipment shall be constructed or protected to withstand the atmospheric and environmental conditions to which they will be subjected.

(Title 24, Part 3, Section 110-11.)

(b) Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.

(c) Cabinets, cutout boxes, fittings, boxes, and panelboard enclosures.

(1) Cabinets, cutout boxes, fittings, boxes, and panelboard enclosures in damp or wet locations shall be installed so as to prevent moisture or water from entering and accumulating within the enclosures and shall be mounted so there is at least 0.25 in. (6.35 mm) airspace between the enclosure and the wall or other supporting surface.

EXCEPTION FOR (c)(1): Nonmetallic enclosures may be installed without the airspace on a concrete, masonry, tile, or similar surface.

(2) Enclosures shall be weatherproof in wet locations.

(d) Switches, circuit breakers, and switchboards.

Switches, circuit breakers, and switchboards installed in wet locations shall be enclosed in weatherproof enclosures.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

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§2714. Installation and Maintenance.

(a) All electrical installations shall be made in a neat and workmanlike manner and shall be so designed, constructed, and installed that the hazard to personnel will be reduced, as far as it is reasonably possible. Installations of new equipment and conductors, and extensions, repairs, and changes in existing installations shall be made only by, or under the supervision or direction of, qualified electrical workers.

~~(Title 24, Part 3, Section 3-110-41.)~~

(b) All electrical installations shall be maintained in a safe operating condition. If any unsafe condition develops, it shall be promptly corrected.

(c) Unused openings in boxes, raceways, auxiliary gutters, cabinets, equipment cases, or housings shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

(d) Conductors shall be racked to provide ready and safe access in underground and subsurface enclosures that persons enter for installation and maintenance.

(e) Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, shall not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues.

(f) There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment, such as parts that are broken, bent, cut, or deteriorated by corrosion, chemical action, or overheating.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

~~§2715. Identification.~~ Electrical Connections.

~~All switches, circuit breakers, and other control devices shall be located or marked to indicate clearly the equipment controlled by them.~~

~~(Title 24, Part 3, Section 3-110-42.)~~

(a) General. Because of different characteristics of dissimilar metals:

(1) Devices such as pressure terminal and pressure splicing connectors shall be identified for the material of the conductor and shall be properly installed and used.

(2) Conductors of dissimilar metals shall not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors (such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum) unless the device is identified for the purpose and conditions of use.

(3) Materials such as inhibitors and compounds, where employed, shall be suitable for the use and shall be of a type that will not adversely affect the conductors, installation, or equipment.

(b) Terminals.

(1) Connection of conductors to terminal parts shall ensure a good connection without damaging the conductors and shall be made by means of pressure connectors (including set-screw type).

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solder lugs, or splices to flexible leads. However, No. 10 or smaller conductors may be connected by means of wire binding screws or studs and nuts having upturned lugs or equivalent.

(2) Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

(c) Splices.

(1) Conductors shall be spliced or joined with splicing devices identified for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be spliced or joined to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device identified for the purpose.

(2) Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(e), Health and Safety Code.~~

§2716.1. Arcing Parts.

Parts of electric equipment which in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2718. Marking.

(a) Identification of manufacturer and ratings. Electric equipment shall not be used unless the following markings have been placed on the equipment:

(1) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified; and

(2) Other markings giving voltage, current, wattage, or other ratings as necessary.

(b) Durability. The marking shall be of sufficient durability to withstand the environment involved.

(c) All switches, circuit breakers, and other control devices shall be located or marked to indicate clearly the equipment controlled by them.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2718.1. Disconnecting Means and Circuits.

(a) Motors and appliances.

Each disconnecting means required by these Electrical Safety Orders for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

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(b) Services, feeders, and branch circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

(c) Durability of markings. The markings required by subsections (a) and (b) of this section shall be of sufficient durability to withstand the environment involved.

(d) Capable of accepting a lock. Disconnecting means required by these Electrical Safety Orders shall be capable of being locked in the open position.

(e) Marking for series combination ratings.

(1) Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosures shall be legibly marked in the field to indicate that the equipment has been applied with a series combination rating.

(2) The marking required by subsection (e)(1) of this section shall be readily visible and shall state "Caution – Series Combination System Rated – Amperes. Identified Replacement Component Required."

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 4. Service and Service Entrance Equipment

§2725. Location of Switching Devices and Other Service Entrance Equipment.

(a) Means shall be provided to disconnect all conductors in a building or other structure from the service-entrance conductors. The service disconnecting means shall plainly indicate whether it is in the open or closed position and shall be installed at a readily accessible location nearest the point of entrance of the service-entrance conductors.

(b) (a) The service disconnecting means ~~switching device(s)~~ shall simultaneously disconnect all ungrounded conductors supplied through the service entrance conductors.

EXCEPTION: NO. 1: Metering equipment shall be permitted to be placed on the source side of the service switching device and fuses, provided the metering is suitably enclosed and no energized parts or wiring are exposed or accessible to other than employees of the serving agency.

EXCEPTION: NO. 2: Current transformers for protection of service equipment or current indication.

EXCEPTION: NO. 3: When suitable overcurrent protection and disconnecting means are provided, a circuit used for any of the following purposes shall be permitted to also be connected on the source side of the service entrance switching device: (a) Fire pumps; and (b) Potential or control transformers for electrical operation or protection of the service equipment, or for voltage indication. If voltage indication is provided, it shall be on all phases.

~~(Title 24, Part 3, Section 3-230-205.)~~

(c) (b) Surge and lightning protection equipment shall be connected to the source side of switching devices.

~~(Title 24, Part 3, Section 3-230-209.)~~

(d) Each service disconnecting means shall be suitable for the prevailing conditions.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Article 5. Feeders and Branch Circuits

§2735. Overcurrent Protection.

(a) Feeders and branch circuits conductors shall have overcurrent protection ~~a fault protective device~~ in each ungrounded conductor located at the point where the conductor receives its supply or at a location in the circuit determined under engineering supervision.

(1) Circuit breakers used for overcurrent protection of three-phase circuits shall have a minimum of three overcurrent relays operated from three current transformers. On three-phase, three-wire circuits, an overcurrent relay in the residual circuit of the current transformers may replace one of the phase relays. An overcurrent relay, operated from a current transformer that links all phases of a three-phase, three-wire circuit, may replace the residual relay and one of the phase-conductor current transformers. Where the neutral is not grounded on the load side of the circuit, the current transformer may link all three phase conductors and the grounded circuit conductor (neutral); and

(2) If fuses are used for overcurrent protection, a fuse shall be connected in series with each ungrounded conductor;

(3) Each ~~The~~ protective device(s) shall be capable of detecting and interrupting all values of current that can occur at its location in excess of its ~~their minimum~~ trip setting or ~~minimum~~ melting point which can occur at their location.

(4) The operating time of the protective device, the available short-circuit current, and the conductor used shall be coordinated to prevent damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions; and

~~A fuse rated in continuous amperes not to exceed three times the nominal rating of the conductor or a breaker with relay having a minimum trip setting of not more than six times the nominal rating of the conductor will be considered as providing the required protection.~~

(5) The nominal rating of the cables will be as required by Section 2821.

(b) The following additional requirements apply to feeders only:

(1) The continuous ampere rating of a fuse shall not exceed three times the ampacity of the conductors. The long-time trip element setting of a breaker or the minimum trip setting of an electronically actuated fuse shall not exceed six times the ampacity of the conductor.

Exception for fire pumps: Conductors may be protected for short circuit only.

EXCEPTION: (2) Taps to a feeder need not have separate fault protective devices, provided that the conductors are capable of withstanding the maximum short circuit current that can occur for the time necessary for a fault protective device on the source side of the conductors to operate. (Title 24, Part 3, Section 3-240-100 and 3-240-101.)

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

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§2738. Identification of Multiwire Branch Circuits.

Where more than one nominal voltage system exists in a building containing multiwire branch circuits, each ungrounded conductor of a multiwire branch circuit, where accessible, shall be identified by phase and system. The means of identification shall be permanently posted at each branch-circuit panelboard.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 6. Grounding

§2739.0. Scope.

This Article contains grounding requirements for systems, circuits, and equipment.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2739.1. Grounding of Systems and Circuits – General.

(a) Grounding of high-voltage systems and circuits is permitted, but is not mandatory unless specifically required elsewhere in these regulations. Where high-voltage systems are grounded, the applicable requirements of this Article 6 shall apply.

~~(b) If the system is to be grounded, a grounding connection shall be made to the system neutral if available. This connection shall be made at or on the source side of the service entrance equipment.~~

~~(b)~~ (e) Grounding connections shall be arranged to prevent objectionable current in the equipment grounding conductor during normal system operation. The temporary current carried by the equipment grounding conductor during fault conditions, while the grounding system is performing its intended protective function, is not objectionable.

~~(d) Grounding equipment and connections shall have ample thermal capacity to carry safely any current which may be imposed on them by the system.~~

~~(c)~~ (e) Grounding connections shall be clamp type, pressure type, welded, or other approved type.

~~(d)~~ (f) Grounding electrodes shall be of corrosion-resistant material and of adequate size, number, and location to effectively ground the system.

~~(e)~~ (g) Local piping systems, well casings, building frames, and the like shall not be used as system grounding electrodes unless their resistance to ground will be maintained low enough to insure effective grounding.

~~(Title 24, Part 3, Section 3-250-150(a)-(g).)~~

~~(h) A system neutral derived from an adequately rated grounding transformer shall be permitted to be used for grounding a high-voltage system.~~

~~(Title 24, Part 3, Section 3-250-151.)~~

~~(i) High-voltage systems supplying portable high-voltage equipment covered by Section 2743 shall be grounded.~~

(f) Identification of conductors.

(1) A conductor used as a grounded conductor shall be identifiable and distinguishable from all other conductors.

(2) A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors.

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(g) Polarity of connections. No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

§2739.4. Grounding Connections.

(a) For a grounded system, a grounding electrode conductor shall be used to connect both the equipment grounding conductor and the grounded circuit conductor to the grounding electrode. Both the equipment grounding conductor and the grounding electrode conductor shall be connected to the grounded circuit conductor on the supply side of the service disconnecting means or on the supply side of the system disconnecting means or overcurrent devices if the system is separately derived.

(b) For an ungrounded service-supplied system, the equipment grounding conductor shall be connected to the grounding electrode conductor at the service equipment. For an ungrounded separately derived system, the equipment grounding conductor shall be connected to the grounding electrode conductor at, or ahead of, the system disconnecting means or overcurrent devices.

(c) Grounding connections shall be clamp type, pressure type, welded, or other approved types. Solder-type connections shall not be used for grounding.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2742. Grounding of Equipment.

(a) The following shall be permanently and effectively grounded before the associated high-voltage equipment is energized.

(1) Metal conduit, cable armor, and other metal raceways or enclosures for wire and cable.

(2) Lightning arrester ground terminals and such other equipment.

(3) Non-energized metal parts of all fixed equipment and associated fences, housings, enclosures, and supporting structures.

(b) Effective grounding of all equipment shall be assured by the use of an equipment grounding conductor, where feasible, such that the path to ground will:

(1) Be permanent, and continuous.

(2) Have ample ampacity to conduct safely any currents liable to be imposed upon it.

(3) Have impedance sufficiently low to limit the potential above ground, and to facilitate the operation of the overcurrent or ground fault detecting devices in the system. Where the conduit is intended to function as the equipment grounding conductor, approved threaded couplings, hubs, and joints, or double locknuts and bushings with bonding jumpers are required.

(c) Unless grounding conductors are an integral part of the cable, they shall be no smaller than No. 6 AWG for mechanical strength. Grounding conductors shall be of corrosion-resistant

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approved material, or shall be suitably protected against corrosion, and shall have thermal capacity for the conditions imposed on them by the system.

~~(d) Grounding connections shall be clamp type, pressure type, welded, or other approved types. Solder type connections shall not be used for grounding.~~

~~(e) Grounding electrodes shall be of corrosion resistant material, and the size number, and the location shall be adequate to provide effective grounding of the equipment.~~

~~(f) Local piping systems, well casings, building frames, and the like shall not be used as grounding electrodes unless their resistance to ground will be maintained low enough to insure effective grounding.~~

~~(g) Noncurrent carrying metal parts of all portable equipment shall be grounded.~~

~~(h) Specific Exceptions.~~

~~(1) Grounding of equipment mounted on poles shall comply with Rules 58.3 C and 58.4 C, General Order No. 95, 1981 Edition Rules for Overhead Electric Line Construction of the California Public Utilities Commission, which are hereby incorporated by reference. (Title 24, Part 3, Section 250-155.)~~

~~(2) Where high voltage equipment and associated metal enclosures or structures are intentionally isolated from ground, provision shall be made to prevent any person who can make contact with ground from contacting the isolated equipment and associated metal enclosures or structures when such equipment is energized. Intentional grounds shall be applied after such equipment is de-energized and before access is permitted, in accordance with Work Procedures, Article 36. (Title 24, Part 3, Section 250-155.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

§2742.0. Grounding Path.

The path to ground from circuits, equipment, and enclosures shall be permanent, continuous, and effective.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2742.1. Grounding of Supports, Enclosures and Equipment.

(a) The following shall be permanently and effectively grounded before the associated high-voltage equipment is energized.

(1) Metal conduit, cable armor, metal cable trays, metal raceways, and other metal raceways or enclosures for conductors.

EXCEPTION for Section 2742.1(a)(1):

Metal enclosures such as sleeves that are used to protect cable assemblies from physical damage need not be grounded.

(2) Lightning arrester ground terminals and such other equipment.

(b) Exposed noncurrent-carrying metal parts of fixed equipment that may become energized shall be grounded under any of the following conditions:

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- (1) If within 8 ft. (2.44 m) vertically or 5 ft. (1.52 m) horizontally of ground or grounded metal objects and subject to employee contact;
- (2) If located in a wet or damp location and not isolated;
- (3) If in electrical contact with metal;
- (4) If in a hazardous (classified) location;
- (5) If supplied by a metal-clad, metal-sheathed, or grounded metal raceway wiring method; or
- (6) If equipment operates with any terminal at over 150 volts to ground.

EXCEPTIONS for Section 2742.1(b):

Exposed noncurrent-carrying metal parts of the following types of fixed equipment need not be grounded:

- 1. Enclosures for switches or circuit breakers used for other than service equipment and accessible to qualified persons only.
- 2. Distribution apparatus, such as transformer and capacitor cases, mounted on wooden poles, at a height exceeding 8.0 ft. (2.44 m) above ground or grade level.

NOTE: Clearances prescribed by the California Public Utilities Commission shall apply where applicable if more protective.

(c) Effective grounding of all equipment shall be assured by the use of an equipment grounding conductor, where feasible, such that the path to ground will:

- (1) Be permanent, and continuous.
- (2) Have ample ampacity to conduct safely any currents liable to be imposed upon it.
- (3) Have impedance sufficiently low to limit the potential above ground, and to facilitate the operation of the overcurrent or ground fault detecting devices in the system. Where the conduit is intended to function as the equipment grounding conductor, approved threaded couplings, hubs, and joints, or double locknuts and bushings with bonding jumpers are required.

(d) Where high-voltage equipment and associated metal enclosures or structures are intentionally isolated from ground, provision shall be made to prevent any person who can make contact with ground from contacting the isolated equipment and associated metal enclosures or structures when such equipment is energized. Intentional grounds shall be applied after such equipment is de-energized and before access is permitted, in accordance with Work Procedures, Article 36.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2742.2. Nonelectrical Equipment.

The metal parts of the following nonelectrical equipment shall be grounded:

- (a) Frames and tracks of electrically operated cranes and hoists.
- (b) Non-energized metal parts of all fixed equipment and associated fences, housings, partitions, grillework and similar metal enclosures, and supporting structures.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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§2742.3. Methods of Grounding Fixed Equipment.

(a) Noncurrent-carrying metal parts of fixed equipment, if required to be grounded by these orders, shall be grounded by an equipment grounding conductor that is contained within the same raceway, cable, or cord, or runs with or encloses the circuit conductors.

EXCEPTION for DC circuits only: The equipment grounding conductor may be run separately from the circuit conductors.

(b) Electric equipment is considered to be effectively grounded if it is secured to, and in electrical contact with, a metal rack or structure that is provided for its support and the metal rack or structure is grounded by the method specified for the noncurrent-carrying metal parts of fixed equipment in subsection 2742.3(a).

(c) For installations made before April 16, 1981, electric equipment is also considered to be effectively grounded if it is secured to, and in metallic contact with, the grounded structural metal frame of a building. When any element of this branch circuit is replaced, the entire branch circuit shall use an equipment grounding conductor that complies with all other provisions of Article 6 of these Orders.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2743. Grounding of Systems and Circuits Supplying Portable High Voltage Equipment.

If high voltage systems are grounded, they shall comply with all applicable provisions of other sections of this Article as supplemented and modified by the following requirements:

(a) Systems supplying portable or mobile high voltage equipment, other than substations installed on a temporary basis, shall comply with the following:

(1) ~~(a) Portable high voltage equipment shall be supplied from a system having its neutral grounded through an impedance.~~ The system shall have its neutral grounded through an impedance.

Where a delta-connected high-voltage system is used to supply ~~portable~~ the equipment, a system neutral shall be derived.

(2) ~~(b)~~ Exposed ~~non-current-carrying non-energized~~ metal parts of portable ~~and mobile~~ equipment shall be connected by an equipment grounding ~~continuous ground return~~ conductor to the point at which the system neutral impedance is grounded ~~connected to earth~~.

(3) ~~(d)~~ Ground fault detection and relaying shall be provided to automatically de-energize any high-voltage system component which has developed a ground fault. The continuity of the equipment grounding ~~ground return~~ conductor shall be continuously monitored so as to de-energize automatically the high-voltage feeder to the portable equipment upon loss of continuity of the equipment grounding ~~ground return~~ conductor.

(4) ~~(e)~~ The grounding electrode to which the portable equipment system neutral impedance is connected shall be isolated from and separated in the ground by at least 20 feet (6.1 m) from any other system or equipment grounding electrode, and there shall be no direct connection between the grounding electrodes, such as buried pipe, fence, etc.

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(b) All Noncurrent-carrying metal parts of all portable and fixed equipment including their associated fences, housings, enclosures, and supporting structures, shall be grounded.

EXCEPTION: Equipment that is guarded by location and isolated from ground need not be grounded.

(c) The product of the maximum ground fault current and the impedance of the ground return conductor shall be such as to limit the voltage developed between the portable equipment frame and ground (by the flow of ground fault current) to not more than 100 volts.

(d) ~~(f)~~ High-voltage trailing cables and couplers for interconnection of portable equipment shall be the type approved for the purpose. See Article 14.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Group 2. High-Voltage Electrical Safety Orders
Article 7. General Requirements – Wiring Methods

§2745.0. Scope. The provisions of this Article do not apply to conductors that are an integral part of factory-assembled equipment.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2745.1. General Requirements.

(a) Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal noncurrent-carrying parts that are to serve as grounding conductors, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings designed so as to make such removal unnecessary.

(b) Where necessary for the reduction of electrical noise (electromagnetic interference) of the grounding circuit, an equipment enclosure supplied by a branch circuit may be isolated from a raceway containing circuits supplying only that equipment by one or more listed nonmetallic raceway fittings located at the point of attachment of the raceway to the equipment enclosure. The metal raceway shall be supplemented by an internal insulated equipment grounding conductor installed to ground the equipment enclosure.

(c) No wiring systems of any type may be installed in ducts used to transport dust, loose stock, or flammable vapors. No wiring system of any type may be installed in any duct used for vapor removal or for ventilation of commercial-type cooking equipment, or in any shaft containing only such ducts.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2745.2. Covers Required.

Suitable covers shall be installed on all boxes, fittings, and enclosures to prevent accidental contact with live parts or physical damage to parts or insulation.

~~(Title 24, Part 3, Section 300-31.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

§2749.1. Aboveground Wiring Methods. ~~Protection Against Induction Heating.~~

(a) Aboveground conductors shall be installed in rigid metal conduit, in intermediate metal conduit, in electrical metallic tubing, in rigid nonmetallic conduit, in cable trays, as busways, as cablebus, in other identified raceways, or as open runs of metal-clad cable suitable for the use

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and purpose. In locations accessible to qualified persons only, open runs of Type MV cables, bare conductors, and bare busbars are also permitted. Busbars shall be either copper or aluminum. Open runs of insulated wires and cables having a bare lead sheath or a braided outer covering shall be supported in a manner designed to prevent physical damage to the braid or sheath.

(b) Conductors emerging from the ground shall be enclosed in approved raceways.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2749.2. Braid-covered insulated conductors – open installations. The braid on open runs of braid-covered insulated conductors shall be flame-retardant or shall have a flame-retardant saturant applied after installation. This treated braid covering shall be stripped back a safe distance at conductor terminals, according to the operating voltage.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 8. Cabinets, Boxes, And Fittings ~~Pull and Junction Boxes~~

§2753. Construction and Installation Requirements.

- (a) Pull boxes shall be made of material inherently resistant to corrosion or shall be suitably protected, both internally and externally, by enameling, galvanizing, plating, or other equivalent means.
- (b) Suitable bushings, shields, or fittings having smooth rounded edges shall be provided where conductors pass through partitions and at other locations where necessary.
- (c) ~~Pull B~~ boxes shall provide a complete enclosure for the contained conductors or cables.
- (d) Pull boxes shall be so installed that the wiring is accessible without removing any part of the building. Working space shall be provided in accordance with Article 35.
- (e) Pull boxes shall be of a type approved for the respective location in which they are installed.
- (f) ~~Pull and junction B~~ boxes shall be effectively closed by suitable covers secured against unauthorized entry. Underground ~~pull~~ box covers that weigh over 100 pounds (45.4 kg) shall be considered secured against unauthorized entry.
- (g) Pull boxes and their covers shall be able to withstand the loading to which they may be subjected.
- (h) Pull boxes shall be securely fastened or set in place.
- (i) Covers for ~~pull and junction~~ boxes ~~used in high-voltage raceway systems~~ shall be labeled "HIGH VOLTAGE." The label shall be on the outside of the box cover and readily visible. Letter shall be block letters at least 1/2 inch in height.
- (j) For grounding, see Article 6.

~~(Title 24, Part 3, Sections 370-52(a)-(e) and 3-370-52(g), (h).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2754.1. Conductors Entering Boxes, Cabinets, or Fittings.

- (a) Conductors entering cutout boxes, cabinets, or fittings shall be protected from abrasion, and openings through which conductors enter shall be effectively closed.
- (b) Unused openings in cabinets, boxes, and fittings shall be effectively closed.
- (c) Where cable is used, each cable shall be secured to the cabinet, cutout box, or meter socket enclosure.

EXCEPTION: Where cable with an entirely nonmetallic sheath enters the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 18 in. (457 mm) or more than 10 ft. (3.05 m) in length, the cable need not be secured to the cabinet, box, or enclosure provided all of the following conditions are met:

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(a) Each cable is fastened within 12 in. (305 mm) of the outer end of the raceway, measured along the sheath;

(b) The raceway extends directly above the enclosure and does not penetrate a structural ceiling;

(c) A fitting is provided on each end of the raceway to protect the cable from abrasion, and the fittings remain accessible after installation;

(d) The raceway is sealed or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway;

(e) The cable sheath is continuous through the raceway and extends into the enclosure not less than 0.25 in. (6.35 mm) beyond the fitting;

(f) The raceway is fastened at its outer end and at other points as necessary; and

(g) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2754.2. Covers and Canopies.

All pull boxes, junction boxes, and fittings shall be provided with covers identified for the purpose. If metal covers are used, they shall be grounded.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 12. Continuous Rigid Cable Supports (Cable Trays)

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

Subchapter 5. Electrical Safety Orders
Group 2. High-Voltage Electrical Safety Orders
Article 14. Portable (Flexible) Cable.

§2790. ~~Use.~~ Conductor Construction. Multiconductor portable cable for use in supplying power to portable or mobile equipment at over 600 volts, nominal, shall consist of No. 8 or larger conductors employing flexible stranding. However, the minimum size of the insulated ground-check conductor of Type G-GC cables shall be No. 10.

~~Cable supplying energy to mobile equipment or machinery shall be IPCEA Type SHD-GC or other approved portable type.~~

EXCEPTION: Portable-type cable is not required to supply mobile equipment that is not frequently moved, provided the cable is suitably protected and will not be moved while energized.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2791. Shielding.

(a) All high-voltage portable cables shall be operated with grounded shielding.

(b) Cables operated at over 2,000 volts shall be shielded for the purpose of confining the voltage stresses to the insulation.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2792. Equipment Grounding Conductors.

(a) Grounding conductors shall be provided.

(b) Identification. A conductor of a flexible cord or cable that is used as a grounded conductor or an equipment grounding conductor shall be distinguishable from other conductors.

(c) Connection of grounding conductors shall be in accordance with Article 6.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2795. Splices and Terminations.

(a) Portable (Flexible) cables shall not be operated with splices unless the splices are of the permanent molded, or vulcanized, or other approved type.

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(b) Terminations. Termination enclosures shall be suitably marked with a high voltage hazard warning, and terminations on high voltage flexible cables shall be accessible only to authorized and qualified personnel.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 15. Temporary Wiring

§2796. Scope.

Except as specifically modified in this Article, all other requirements of these Safety Orders for permanent wiring shall also apply to temporary wiring installations.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2797. Use.

Temporary electrical installations of more than 600 volts may be used only dDuring periods of construction, test, experiment, or emergencies, a less permanent class of wiring and equipment shall be permitted to be used than would be required for permanent installations.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2799.0. Time Limit.

(a) Temporary wiring as permitted in this section shall not be used for a period exceeding 90 days, except for construction purpose in which case it may be used for not to exceed one year. If necessary to exceed the above time limitation, special permission shall be obtained from the enforcing authority.

(b) All temporary wiring shall be removed immediately upon the completion of the project construction or purpose for which the wiring was installed; or upon the expiration of the time limit specified above.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2799.1. Feeders. The following requirements apply to feeders:

(a) Feeders shall originate in an approved distribution center.

(b) Conductors shall be run as multi-conductor cord or cable assemblies. However, if installed as permitted in Section 2797, and if accessible only to qualified persons, feeders may be run as single insulated conductors.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2799.2. Branch Circuits. The following requirements apply to branch circuits:

(a) Branch circuits shall originate in an approved panelboard.

(b) Conductors shall be multiconductor cord or cable assemblies or open conductors.

(c) No branch-circuit conductor may be laid on the floor.

(d) Each branch circuit that supplies fixed equipment shall contain a separate equipment grounding conductor if run as open conductors.

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NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code

§2799.3. No bare conductors nor earth returns may be used for the wiring of any temporary circuit.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2799.4. Suitable disconnecting switches shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit. Multiwire branch circuits shall be provided with a means to disconnect simultaneously all ungrounded conductors at the power outlet or panelboard where the branch circuit originated.

NOTE: Circuit breakers with their handles connected by approved handle ties are considered a single disconnecting means for the purpose of this requirement.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2799.5. Flexible cords and cables shall be protected from accidental damage, as might be caused, for example, by sharp corners, projections, and doorways or other pinch points.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2799.6. Cable assemblies and flexible cords and cables shall be supported in place at intervals that ensure that they will be protected from physical damage. Support shall be in the form of cable ties, straps, or similar type fittings installed so as not to cause damage.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 17. ~~Vaults and Enclosures~~ for Electrical Installations

§2805. Vaults—General.

Transformer vaults shall be constructed so as to contain fire and combustible liquids within the vault and to prevent unauthorized access.

(a) Strength. Vault structures shall have sufficient strength to withstand the loading to which they may be subjected and to support the equipment mounted therein.

(b) Wall Material. Vault interior walls shall be of assemblies of materials approved for not less than one-hour, non-combustible fire-resistive construction.

(c) Doors. Door openings to vaults shall be protected by approved one-hour rated fire door and frame assemblies.

(d) Ceiling Access. Vault ceiling access opening covers or grates weighing less than 100 pounds shall be securely fastened in place. Openings must be minimum of 26 inches diameter or 24 inches by 26 inches in size. Safe access shall be provided from the opening to the floor or other working surface.

(e) Ventilating Ducts. All ventilating flues or ducts shall be of noncombustible construction.

(f) Ventilating Openings. Ventilating openings shall not be through the vault door, except where door opens to outdoors.

(g) Adequate Ventilation. Vaults shall be provided with means for ventilation adequate to prevent equipment temperatures in excess of those at which the equipment may be safely operated.

(h) Drainage. Where drainage from sumps in vaults is to a sewage system, a suitable trap shall be installed capable of preventing the entrance of sewer gas into the vault.

(i) Foreign Pipes and Accessories. ~~Pipelines such as sewer, water, gas, oil, etc., in as far as is practicable, shall be installed outside the vault enclosure unless they constitute an integral part of operation of the equipment installed in the vault. Where it is impracticable for such lines to be installed outside the vault, they shall contain no appurtenances (such as valves, faucets, or fittings) inside the vault that require maintenance.~~ Any pipe or duct system foreign to the electrical installation shall not enter or pass through a transformer vault.

EXCEPTION: Piping or other facilities provided for vault fire protection, or for transformer cooling, are not considered foreign to the electrical installation.

(Title 24, Part 3, Section 3-110-35.)

(j) Material shall not be stored in transformer vaults.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(c), Health and Safety Code.

§2810. Locked Rooms, Vaults, or Enclosures.

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(a) The entrances to enclosures containing exposed high-voltage energized parts shall be kept locked, except where such entrances are at all times under the observation of a qualified attendant. Access doors or gates to rooms, vaults, or fenced enclosures containing electrical equipment shall be readily opened from the inside without the use of a key.

(b) The type of enclosure used in a given case shall be designed and constructed according to the hazards associated with the installation.

~~(Title 24, Part 3, Section 3-110-34(c).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2812.1. Fenced or Walled Enclosures.

(a) The height of enclosures shall be 8 feet minimum, or floor to ceiling if the ceiling is less than 8 feet.

EXCEPTIONS:

1. A fenced enclosure shall be not less than 8 ft. in height or a combination of 7 ft. or more (vertical) of fence fabric and an extension not less than 1 ft. in vertical height utilizing three or more strands of barbed wire or equivalent.

(2) The height of the enclosure shall be not less than 10 feet where any exposed energized part is more than 8 feet above the ground, unless the energized part is located more than 5 feet horizontally from the enclosure.

(b) The enclosure shall be so constructed that it cannot be readily climbed.

(c) The size and location of openings in fences or similar enclosures shall be such that persons are not liable to come into accidental contact with energized parts, or to bring conducting objects into contact with them.

(d) The gate or door in the enclosure shall have minimum dimensions of 2 feet 6 inches wide and 6 feet 6 inches high, and shall be readily operable. No reduction in enclosure height at the door or gate is permitted.

(e) Metal gates or doors shall be grounded or bonded to a grounded metal enclosure. Metal fences shall be grounded as required by Article 6.

(f) If buildings form a part of an enclosure, there shall be no unguarded doors or windows which permit unintentional access to the enclosure. Where the enclosure is adjacent to and below stairways, fire escapes, balconies, or windows, suitable guards shall be installed to prevent persons from making accidental contact with energized parts.

(g) Where oil-filled apparatus is installed within an enclosure adjacent to combustible material or combustible buildings, provision shall be made to confine within the enclosure the largest amount of oil contained in a single piece of apparatus.

(h) Pressure relief devices of oil-filled apparatus shall be designed and located to minimize the hazard to persons from escaping oil.

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(i) Materials other than those required for operation of the facilities shall not be stored in vaults or fenced enclosures.

~~(Title 24, Part 3, Section 3-110-31(e)-(m).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(e), Health and Safety Code.~~

§2812.2. Indoor installations accessible to other than qualified persons.

The following requirements apply to indoor installations that are accessible to other than qualified persons:

(a) The installations shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area to which access is controlled by a lock.

(b) Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs; and

(c) Openings in ventilated dry-type transformers and similar openings in other equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2812.3. Outdoor Electrical Installations.

(a) Outdoor electrical installations having exposed live parts shall be accessible to qualified persons only.

(b) The following requirements apply to outdoor enclosed equipment accessible to unqualified personnel:

(1) Ventilating or similar openings in equipment shall be so designed that foreign objects inserted through these openings will be deflected from energized parts;

(2) Where exposed to physical damage from vehicular traffic, suitable guards shall be provided;

(3) Nonmetallic or metal-enclosed equipment located outdoors and accessible to the general public shall be designed so that exposed nuts or bolts cannot be readily removed, permitting access to live parts;

(4) Where nonmetallic or metal-enclosed equipment is accessible to the general public and the bottom of the enclosure is less than 8.0 ft. (2.44 m) above the floor or grade level, the enclosure door or hinged cover shall be kept locked; and

(5) Except for underground box covers that weigh over 100 lb. (45.4 kg), doors and covers of enclosures used solely as pull boxes, splice boxes, or junction boxes shall be locked, bolted, or screwed on.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 18. Conductors

§2816. Insulation.

(a) Conductors shall be insulated, except where uninsulated conductors are specifically permitted by these orders, and shall have a voltage rating not less than the operating voltage of the circuit.

~~(Title 24, Part 3, Section 3 310 2(a).)~~

(b) The conductor insulation shall be of a type that is approved for the voltage, operating temperature, and location of use.

(1) ~~(a)~~ Wet Locations. Conductors installed in wet locations either above or below ground shall be moisture-resistant or of a type approved for use under wet conditions.

~~(Title 24, Part 3, Section 3 310 7.)~~

(2) ~~(b)~~ Corrosive Conditions. Conductors exposed to oils, greases, vapors, gases, fumes, liquids, or other substances having a deleterious effect upon the conductor or the insulation shall be of a type approved for the use.

~~(Title 24, Part 3, Section 3 310 8.)~~

(c) Distinguishable. Insulated conductors shall be distinguishable by appropriate color or other suitable means as being grounded conductors, ungrounded conductors, or equipment grounding conductors.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2819. Conductor Terminations.

(a) Where insulated conductors are terminated or spliced, suitable terminations or stress cones shall be installed unless other effective means are used to reduce voltage stress. The metallic shielding or any other voltage shields on cables shall be stripped back to a safe distance according to the circuit voltage and insulation, at all terminations of the shielding, as in potheads and joints.

~~(Title 24, Part 3, Section 3 710 6.)~~

(b) Moisture or mechanical protection for metal-sheathed cables. Where cable conductors emerge from a metal sheath and where protection against moisture or physical damage is necessary, the insulation of the conductors shall be protected by a cable sheath terminating device.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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§2820. Grounding of Shielding.

Metallic shielding ~~tape~~ components such as tapes, wires, or braids, or combinations thereof, and their associated conducting and semi-conducting components shall be grounded in accordance with Article 6.

~~(Title 24, Part 3, Section 3 710-6.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Article 20. Switches Interrupting and Isolating Devices

§2832. A means shall be provided to completely isolate equipment for inspection and repairs. Isolating means that are not designed to interrupt the load current of the circuit shall be either interlocked with an approved circuit interrupter or provided with a sign warning against opening them under load.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code

§2833. Interrupter Switches.

(a) Rating.

(1) Continuous Current Rating. The continuous current rating of interrupter switches shall equal or exceed the maximum continuous current at the point of installation.

(2) Interrupting Rating. The current interrupting rating of interrupter switches shall equal or exceed the maximum current which the switch will be required to interrupt.

(3) Momentary Rating. The momentary rating of interrupter switches shall equal or exceed the asymmetrical short circuit current available at the switch location. The asymmetrical short circuit current shall include contributions from all connected sources of energy, such as other lines, generators, large motors, etc.

(4) Fault Closing Rating. Interrupter switches shall have a fault closing rating equal to or greater than the asymmetrical short circuit current which can occur at the switch location, unless suitable interlocks or operating procedures preclude the possibility of closing into a fault.

(5) Voltage Rating. The maximum voltage rating of interrupter switches shall equal or exceed the maximum circuit voltage.

(b) Enclosure. Circuit breaker installations located indoors shall consist of metal-enclosed units or fire-resistant cell-mounted units ~~Interrupter switches installed indoors shall have a metal enclosure,~~ or shall be installed in a room of at least 2-hour fire-resistive construction, or in a transformer vault.

(1) In locations accessible only to qualified electrical workers, open mounting of circuit breakers is permitted.

(2) A means of indicating the open and closed position of circuit breakers shall be provided.

(c) Installation Requirements. Interrupter switches shall be so installed that the center of the grip of the operating handle of the switch, when in its uppermost position, will be not more than 6 1/2 feet above the floor or working platform.

(d) Enclosures as Raceways. Switch enclosures shall not be used as raceways for conductors feeding through, or tapping off, to other switches, unless adequate space is provided for this purpose.

(e) Switching of Conductors. The switching mechanism shall be arranged to be operated from a location where the operator is not exposed to energized parts and shall be arranged to open all

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ungrounded conductors of the circuit simultaneously with one operation. Switches shall be arranged to be locked in the open position. Metal-enclosed switches shall be operable from outside the enclosure.

~~(f) Knife Switches. All knife switch blades shall be de-energized when the switch is in the open position.~~

~~EXCEPTION: The blades of switches used to connect a load to more than one source of supply shall be permitted to be energized when in the open position if (1) suitable barriers or enclosures are installed over the switches to prevent accidental contact with the energized switch blades; and (2) a conspicuous permanent sign is placed on the outside of the barrier or enclosure warning that the switch blades may be energized in any position.~~

~~(f) (g) Fuses.~~ Fuses installed with interrupter switches shall comply with the requirements of Article 24.

~~(g) (h) Readily and Safely Accessible.~~ Interrupter switches, except those installed on poles or structures, shall be so located that they may be operated or maintained from a readily and safely accessible place.

~~(h) (i) Identification.~~ Interrupter switches shall have a permanent and legible nameplate including the following information: manufacturer's type or designation, continuous current rating, interrupting current rating, momentary current rating, fault closing rating, and maximum voltage rating.

~~(i) (j) Stored Energy for Opening.~~ The stored energy operator shall be permitted to be left in the uncharged position after the switch has been closed if a single movement of the operating handle charges the operator and opens the switch.

~~(Title 24, Part 3, Section 3-710-21(e).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2833.1. Knife Switches.

(a) Single-throw knife switches. Single-throw knife switches shall be so placed that gravity will not tend to close them. Single-throw knife switches approved for use in the inverted position shall be provided with a locking device that will ensure that the blades remain in the open position when so set.

(b) Double-throw knife switches.

Double-throw knife switches shall be mounted so that the throw will be either vertical or horizontal. However, if the throw is vertical, a locking device shall be provided to ensure that the blades remain in the open position when so set.

(c) Connection of switches.

(1) Single-throw knife switches and switches with butt contacts shall be connected so that the blades are deenergized when the switch is in the open position.

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(2) Single-throw knife switches, molded-case switches, switches with butt contacts, and circuit breakers used as switches shall be connected so that the terminals supplying the load are deenergized when the switch is in the open position.

(3) Blades and terminals supplying the load of a switch may be energized when the switch is in the open position where the switch is connected to circuits or equipment inherently capable of providing a backfeed source of power. For such installations, a permanent sign shall be installed on the switch enclosure or immediately adjacent to open switches that reads: "WARNING – LOAD SIDE TERMINALS MAY BE ENERGIZED BY BACKFEED."

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2833.2. Load Interrupter Switches.

Load interrupter switches may be used only if suitable fuses or circuits are used in conjunction with these devices to interrupt fault currents.

(a) Where these devices are used in combination, they shall be coordinated electrically so that they will safely withstand the effects of closing, carrying, or interrupting all possible currents up to the assigned maximum short-circuit rating.

(b) Where more than one switch is installed with interconnected load terminals to provide for alternate connection to different supply conductors, each switch shall be provided with a conspicuous sign reading: "WARNING – SWITCH MAY BE ENERGIZED BY BACKFEED."

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

~~Subchapter 5. Electrical Safety Orders~~
~~Group 2. High Voltage Electrical Safety Orders~~
~~Article 21. Circuit Breakers~~
[Ed note: Merge Art. 21 into new Art. 20]

§2837. Ratings. *[No changes proposed]*

§2838. Grounding. *[No changes proposed]*

§2839. General. *[No changes proposed]*

§2840. Identification. *[No changes proposed]*

§2841. Isolation. *[No changes proposed]*

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~~Article 22. Automatic Circuit Reclosers~~

[Ed note: Merge Art. 22 into new Art. 20]

§2843. General. *[No changes proposed]*

~~Subchapter 5. Electrical Safety Orders~~

~~Group 2. High Voltage Electrical Safety Orders~~

~~Article 23. Power Fuses~~

[Ed note: Merge Art. 23 into new Art. 20]

§2845. Power Fuses.

(a) Use. Where fuses are used to protect conductors and equipment, a fuse shall be placed in each ungrounded conductor.

(1) Parallel (Multiple) Power Fuses. Two power fuses shall be permitted to be used in parallel (multiple) to protect the same load, provided:

(A) Both fuses have identical ratings, and

(B) Both fuses are installed in an identified common mounting with electrical connections that will divide the current equally.

(b) Vented Power Fuses. Power fuses of the vented type shall not be used indoors, underground or in metal enclosures unless identified for the use.

(c) Interrupting Rating. The interrupting rating of power fuses shall equal or exceed the maximum fault current the fuse will be required to interrupt, including contributions from all connected sources of energy.

(d) Voltage Rating. The maximum voltage rating of power fuses shall equal or exceed the maximum circuit voltage. Fuses having a minimum recommended operating voltage shall not be applied below this voltage.

(e) Installation. Fuses shall be installed in suitable metal enclosures. Exception: Fuses shall be permitted to be installed without metal enclosures in substations, vaults, or outdoor locations.

(f) Structure Mounted Indoor or Outdoor. The height of fuse mountings on structures shall provide safe clearance between lowest energized part (open or closed position) and standing surface. For mounting heights, see Article 35.

(g) Disconnecting Means. A suitable means shall be installed to isolate each fuse from all sources of potential. Provision for installation and removal of the fuse by suitable live line tools meets this requirement.

(h) Identification of Fuse Mountings and Fuse Units. The fuse mountings and fuse units shall be permanently and legibly identified to include the following information: manufacturer's type or designation, continuous current rating, interrupting current rating, and maximum voltage rating.

(i) Clear Workspace. Space shall be provided for fuse handling in accordance with Article 35.

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(j) Door Interlock. Means shall be provided to prevent access to fuses installed in metal enclosures until all sources of energy are disconnected.

(k) Enclosed Fuse Types. Fuses installed in metal enclosures shall be of the non-vented or controlled-vented type. Adequate volume or other means shall be provided to prevent the operation of fuses from causing dangerous pressures in enclosures.

(l) Fused cutouts installed in buildings or transformer vaults shall be of a type approved for the purpose. They shall be readily accessible for fuse replacement.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

~~Subchapter 5. Electrical Safety Orders
Group 2. High Voltage Electrical Safety Orders
Article 24. Distribution Cutouts and Fuse Links--Expulsion Type
[Ed note: Merge Art. 24 into new Art. 20]~~

§2847. Distribution Cutouts and Fuse Links--Expulsion Type.

(a) Installation. The cutouts shall be so located that they may be readily and safely operated and refused, and so that the exhaust of the fuses will not endanger persons. Distribution cutouts shall not be used indoors, underground, or in metal enclosures.

~~(Title 24, Part 3, Section 710 21(e)(1).)~~

(b) Interrupting Rating. The interrupting rating of distribution cutouts shall equal or exceed the maximum fault current which can occur at the fuse location. The available fault current at the fuse location shall include contributions from all connected sources of energy, such as the other lines, generators, large motors, etc.

~~(Title 24, Part 3, Section 710 21(e)(3).)~~

(c) Voltage Rating. The maximum voltage rating of cutouts shall equal or exceed the maximum circuit voltage.

~~(Title 24, Part 3, Section 710 21(e)(4).)~~

(d) Operation. Where fused cutouts are not suitable to interrupt the circuit manually while carrying full load, an approved means shall be installed to interrupt the entire load.

Unless the fused cutouts are interlocked with the switch to prevent opening of the cutouts under load, a conspicuous sign shall be placed at such cutouts reading, "Warning – Do Not Operate ~~Open~~ Under Load."

~~(Title 24, Part 3, Section 710 21(e)(2).)~~

(e) Identification. Distribution cutouts and fuse links shall have a permanent and legible nameplate or identification including the following information:

(1) Cutout Body, Door, or Fuse Tube. Manufacturer's type or designation, continuous current rating, maximum voltage rating, interrupting rating.

~~(Title 24, Part 3, Section 710 21(e)(5).)~~

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(2) Fuse Links. Continuous current rating, type identification following the continuous current rating.

~~(Title 24, Part 3, Section 710-21(e)(6).)~~

(f) Structure Mounted Outdoors. The height of cutouts mounted outdoors on structures shall provide safe clearance between lowest energized parts (open or closed position) and standing surfaces. For mounting heights, see Articles 19 and 35.

~~(Title 24, Part 3, Section 710-21(e)(7).)~~

(g) Clear Workspace. Space shall be provided for fuse handling in accordance with Article 35.

~~(Title 24, Part 3, Section 3-710-21(e)(8).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

~~Subchapter 5. Electrical Safety Orders
Group 2. High Voltage Electrical Safety Orders
Article 25. Oil Filled Cutouts
[Ed note: Merge Art. 25 into new Art. 20]~~

§2849. Continuous Current Rating. *[No changes proposed]*

§2850. Interrupting Rating. *[No changes proposed]*

§2851. Voltage Rating. *[No changes proposed]*

§2852. Fault Closing Rating. *[No changes proposed]*

§2853. Location. *[No changes proposed]*

§2854. Identification. *[No changes proposed]*

§2855. Enclosure. *[No changes proposed]*

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Article 26. Metal-Enclosed Power Switchgear and Industrial Control Assemblies

§2863. Accessibility of Energized Parts.

(a) Doors or removable panels which could provide non-qualified persons access to high-voltage energized parts shall be locked or secured by other approved means. When high-voltage metal-enclosed switchgear or control assemblies are accessible only to qualified persons, bolted-on or hinged and bolted cover plates shall be permitted to be used.

(b) Low-voltage control equipment, relays, motors, and the like (except instrument or control transformers which are connected to the high voltage) shall not be installed in compartments with exposed high-voltage energized parts or high-voltage wiring unless the access door or cover is interlocked with the high-voltage switch or disconnecting means to prevent the door or cover from being opened or removed unless the switch or disconnecting means is in the open position.

~~(Title 24, Part 3, Section 710-24 (f).)~~

(c) Switchboards with exposed live parts. Switchboards that have any exposed live parts shall be located in permanently dry locations and shall be accessible only to qualified persons.

(d) Panelboard enclosures. Panelboards shall be mounted in cabinets, cutout boxes, or enclosures designed for the purpose and shall be dead front. However, panelboards other than the dead front externally-operable type are permitted where accessible only to qualified persons.

(e) Knife switches mounted in switchboards or panelboards. Exposed blades of knife switches mounted in switchboards or panelboards shall be dead when open.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Article 27. Transformers

§2873. Scope.

This article applies to the installation of all transformers, including voltage and current regulators or regulating transformers.

EXCEPTION:

Control, instrument, and other transformers which constitute an integral part of other apparatus (test equipment, X-ray, diathermic, welders, rectifiers, mobile equipment, high frequency, or electrostatic-coating apparatus, etc.) and conform to the requirements of such other apparatus.

~~(Title 24, Part 3, Section 3-450-1.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2874. General.

(a) Ventilation. Adequate ventilation shall be provided to assure safe operating temperature of apparatus.

~~(Title 24, Part 3, Section 3-450-9.)~~

(b) Protection from Physical Damage. Transformers and attachments, such as conductors and externally mounted devices, shall be protected from physical damage by suitable barriers, guards, or location.

~~(Title 24, Part 3, Section 3-450-8(a).)~~

(c) Identification. Each transformer shall be identified by a permanent nameplate which includes the following information:

(1) The word(s) "Transformer," "Voltage Regulating Transformer," or "Voltage Regulator."

(2) Manufacturer's name, type, and serial designation.

(3) Rated KVA, phases, and frequency.

(4) Voltage ratings and tap voltages.

(5) Connection diagram.

(6) Polarity (single phase).

(7) Impedance.

(8) Rated temperature rise in degrees centigrade.

(9) Identification of insulating medium.

(10) Amount of insulating liquid (not required for sizes 167 KVA and smaller).

(11) Approximate total weight (not required for sizes 25 KVA and smaller).

~~(Title 24, Part 3, Section 3-450-11.)~~

(d) Access Openings. Access openings to transformer enclosures shall be provided with a means for locking or otherwise preventing unauthorized access.

~~(Title 24, Part 3, Section 3-450-13.)~~

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(e) Signs.

(1) A permanent, legible, and clearly visible "HIGH VOLTAGE" warning sign, having letters at least 2 inches high, shall be located on the access opening of each transformer enclosure. These signs shall read substantially as follows: "Danger--High Voltage--Keep Out."

~~(Title 24, Part 3, Section 3-450-14.)~~

(2) The operating voltage of exposed live parts of transformer installations shall be indicated by signs or visible markings on the equipment or structure.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(e), Health and Safety Code.~~

§2875. Requirements Applicable to Specific Types and Locations of Transformers.

(a) Indoor Installations. Oil-insulated transformers shall not be installed indoors except in a vault constructed in accordance with Sections 2805 and 2806, or a separate building meeting the requirements of Section 2807.

~~(Title 24, Part 3, Section 3-450-26(a).)~~

(b) High Fire Point Liquid-Insulated Transformers. Transformers insulated with a listed, less flammable liquid (high fire point) shall be permitted to be installed without a vault in a non-combustible occupancy area of non-combustible buildings, provided there is a liquid confinement area and the liquid is listed as having a fire point of not less than 300 degrees C. Such transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

~~(Title 24, Part 3, Section 3-450-23.)~~

(c) Dry-type, high fire point liquid-insulated, and askarel-insulated transformers installed indoors and rated over 35kV shall be in a vault.

(d) ~~(e)~~ Protection from Flooding. Transformers and associated equipment subject to flooding shall be submersible.

~~(Title 24, Part 3, Section 3-450-29.)~~

(e) ~~(d)~~ Protection Against Toxic Gases. Precautions shall be taken to prevent transformers from venting toxic or explosive gases into an inadequately ventilated space.

~~(Title 24, Part 3, Section 3-450-30.)~~

(f) ~~(e)~~ Outdoor Installations. Transformers shall be permitted to be installed in outdoor enclosures meeting the requirements of Section 2812.1 or on roofs in accordance with Section 2808. Transformers installed on poles or structures shall conform to Rule 58.3, General Order No. 95, 1981 Edition, Rules for Overhead Electric Line Construction of the California Public Utilities Commission, which is hereby incorporated by reference. Transformers installed underground shall conform to Rule 34.2C, General Order No. 128, 1974 Edition, Rules for Construction of Underground Electric Supply and Communications Systems of the California Public Utilities Commission which is hereby incorporated by reference

~~(Title 24, Part 3, Section 3-450-27.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(e), Health and Safety Code.~~

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Article 28. Rotating Machinery and Its Control Apparatus

§2880. Scope.

The provisions of this article apply to any rotating machine with normal rated operating voltages in excess of 600 volts between conductors or conductors to ground and to the circuits and control apparatus directly associated with such a machine.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

~~§2882.1. Control of Motors and Generators.~~

~~(a) Motors. Within Sight Of.~~

If specified in this article that one piece of equipment shall be “within sight of” another piece of equipment, the piece of equipment shall be visible and not more than 50.0 ft. (15.24 m) from the other.

~~(b) (1) Controls.~~

(1) Each motor shall be provided with a means for starting and stopping. The switching means shall meet the requirements of Sections 2833 and 2837. A properly coordinated and rated combination of current-limiting fuses and contactor will meet these requirements.

~~(Title 24, Part 3, Section 3-430-129(a).)~~

(c) Disconnecting Means.

(1) An individual disconnecting means shall be provided for each controller. A disconnecting means shall be located within sight of the controller location.

EXCEPTIONS to (c)(1):

1. A single disconnecting means may be located adjacent to a group of coordinated controllers mounted adjacent to each other on a multi-motor continuous process machine.

2. The controller disconnecting means for motor branch circuits over 600 volts, nominal, shall be permitted to be out of sight of the controller, if the controller is marked with a warning label giving the location and identification of the disconnecting means which is to be locked in the open position.

~~(Title 24, Part 3, Section 430-102.)~~

(2) Isolation. A means shall be installed to isolate each motor and its controller from all sources of potential. The isolating means shall meet requirements of Section 2835 (b).

~~(Title 24, Part 3, Section 3-430-129(b).)~~

(3) The disconnecting means shall disconnect the motor and the controller from all ungrounded supply conductors and shall be so designed that no pole can be operated independently.

(4) The disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position.

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(5) The disconnecting means shall be readily accessible. If more than one disconnect is provided for the same equipment, only one need be readily accessible.

~~(b) Generators.~~

~~(1) Each generator shall be provided with a load switching device meeting the requirements of Section 2833 or 2837. A properly coordinated and rated combination of current limiting fuses and contactor will meet this requirement.~~

~~(2) Isolation. A means shall be installed to isolate each generator from all sources of potential. The isolating means shall meet the requirements of Section 2835 (b).~~

~~(3) Excitation Control. The generator excitation system shall include a means for safely interrupting excitation current.~~

~~(Title 24, Part 3, Section 3-445-9.)~~

~~(d) (e) General Application – Motors.~~

~~(1) Several Motors Served by a Single Disconnecting Means. An individual disconnecting means shall be provided for each motor.~~

EXCEPTION to (d)(1): A single disconnecting means may be used for ~~can~~ serve a group of motors under any one of the following conditions:

1. A number of motors driving the several parts of a single machine, where the construction or use of the machine is such that it would be impractical to attempt to repair the motor, controller, or machine while any part of the machine is in operation.

2. If a group of motors is under the protection of one set of branch-circuit protective devices;
or

3. If a group of motors is in a single room within sight of the location of the disconnecting means.

~~(2) Undervoltage Protection. Means shall be provided to prevent automatic restarting of motors after undervoltage tripping if automatic starting would constitute a hazard to persons.~~

Motors, motor-control apparatus, and motor branch-circuit conductors shall be protected against overheating due to motor overloads or failure to start, and against short-circuits or ground faults.

These provisions do not require overload protection that will stop a motor where a shutdown is likely to introduce additional or increased hazards, as in the case of fire pumps, or where continued operation of a motor is necessary for a safe shutdown of equipment or process and motor overload sensing devices are connected to a supervised alarm.

~~(3) Control Circuits. High-voltage portions of control circuits shall be protected against fault currents as provided in Section 2883.~~

~~(Title 24, Part 3, Section 3-430-129(e).)~~

~~NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; and Section 18943(e), Health and Safety Code.~~

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§2882.2. Generators.

(a) Each generator shall be provided with a load switching device meeting the requirements of Section 2833 or 2837. A properly coordinated and rated combination of current-limiting fuses and contactor will meet this requirement.

(b) Isolation. A means shall be installed to isolate each generator from all sources of potential. The isolating means shall meet the requirements of Section 2835 (b).

(c) Excitation Control. The generator excitation system shall include a means for safely interrupting excitation current.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 29. Capacitors

§2890. Switching.

(a) Load Current. Single-pole individually operated or multi-pole group-operated switches used for capacitor switching shall be capable of:

- (1) carrying continuously not less than 135 percent of the rated current of the capacitor installation;
- (2) interrupting the maximum continuous load current of each capacitor, capacitor bank, or capacitor installation that will be switched as a unit; ~~and~~
- (3) withstanding the maximum inrush current, including contributions from adjacent capacitor installations; and
- (4) carrying currents due to faults on the capacitor side of the switch.

~~(Title 24, Part 3, Section 460-24 (a).)~~

(b) Isolation.

- (1) A means shall be installed to isolate from all sources of voltage ~~potential~~ each capacitor, capacitor bank, or capacitor installation that will be removed from service as a unit.
- (2) The isolating means shall provide a visible gap in the electrical circuit adequate for the operating voltage.
- (3) Isolating or disconnecting switches (with no interrupting rating) shall be ~~mechanically~~ interlocked with the load interrupting device or shall be provided with prominently displayed caution signs in accordance with Section 2835 (h) to prevent switching load current.

~~(Title 24, Part 3, Section 460-24 (b).)~~

(c) Additional Requirements for Series Capacitors. The proper switching sequence shall be assured by use of at least one of the following:

- (1) Mechanically sequenced isolating and bypass switches.
- (2) Interlocks.
- (3) Switching procedure prominently displayed at the switching location.

~~(Title 24, Part 3, Section 460-24(e).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2893. Means for Discharge.

- (a) A means shall be provided to reduce the residual voltage of a capacitor to 50 volts or less within 5 minutes after the capacitor is disconnected from the source of supply.
- (b) A discharge circuit shall be ~~either permanently connected to the terminals of the capacitor or~~ provided with automatic means of connecting it to the terminals of the capacitor bank after disconnection of the capacitor from the source of supply. The windings of motors, or

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transformers, or of other equipment directly connected to capacitors without a switch or overcurrent device interposed must meet the requirements of subsection (a) above.

(c) Capacitors shall not be worked on until after they have been short circuited and grounded. The internal discharge device provided in capacitors shall not be used as a substitute for externally short circuiting and grounding capacitors.

~~(Title 24, Part 3, Section 460-28.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Article 32. Mobile and Portable Equipment

§2908. Enclosures.

(a) All energized switching and control parts shall be enclosed in effectively grounded metal cabinets or enclosures. These cabinets or enclosures shall be marked "DANGER--HIGH VOLTAGE" and shall be locked so that only authorized and qualified persons can enter. Circuit breakers and protective equipment shall have the operating means projecting through the metal cabinet or enclosure so these units can be reset without opening locked doors. With doors closed, reasonable safe access for normal operation of these units shall be provided.

(b) Collector ring assemblies on revolving-type machines (shovels, draglines, etc.) shall be guarded.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2910. Power Cable Connections to Mobile Machines.

A metallic enclosure shall be provided on the mobile machine for enclosing the terminals of the power cable. The enclosure shall include provisions for a solid connection for the grounding ~~ground wire(s)~~ terminal to effectively ground the machine frame. Ungrounded conductors shall be attached to insulators or terminated in approved high-voltage cable couplers (which include ground wire connectors) of proper voltage and ampere rating. The method of cable termination used shall prevent any strain or pull on the cable from stressing the electrical connections. The enclosure shall have provision for locking so only authorized and qualified persons may open, and shall be marked "DANGER--HIGH VOLTAGE."

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 35. Workspace and Guarding

§2931. Entrance and Access to Workspace.

(a) At least one entrance not less than 24 inches wide and 6 1/2 feet high shall be provided to give access to the working space about electrical equipment.

(1) On switchboard and control panels exceeding 48 inches in width, there shall be one entrance at each end of such boards ~~where reasonably practicable~~. unless the location of the switchboards and control panels permits a continuous and unobstructed way of exit travel, or unless the work space required in Section 2932(a) is doubled.

(2) Where one entrance to the working space is permitted under the conditions described in subsection 2931(a)(1), the entrance shall be located so that the edge of the entrance nearest the switchboards and control panels is at least the minimum clear distance given in Table 2932 away from such equipment.

(3) Where bare energized parts at any voltage, or insulated energized parts above 600 volts, nominal, to ground are located adjacent to such entrance, they shall be suitably guarded.

(Title 24, Part 3, Section 110-33(a).)

(b) ~~Permanent or portable ladders, or stairways, or other suitable means~~ shall be provided to give safe access to the working space around electrical equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.

(Title 24, Part 3, Section 3-110-33(b).)

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2932. Workspace.

(a) The minimum depth of clear working space about electrical equipment, such as switchgear, motor controllers, etc., shall not be less than set forth in ~~the following table~~ Table 2932 unless otherwise specified in these orders. Clearances shall be measured from the energized parts if parts are exposed or from the enclosure front or opening, if parts are enclosed.

Table 2932 – Minimum Depth of Clear Working Space at Electric Equipment, Over 600 Volts

Nominal Voltage to Ground	MINIMUM CLEAR DISTANCE FOR CONDITIONS					
	Condition 1		Condition 2		Condition 3	
	Feet	Meters	Feet	Meters	Feet	Meters
601-2500	3	0.9	4	1.2	5	1.5
2501-7500	4	1.2	5	1.5	6	1.8
7501-25,000	5	1.5	6	1.8	9	2.8
25,001-75kv	6	1.8	8	2.5	10	3.0
Above 75kv	8	2.5	10	3.0	12	3.7

Where the conditions are as follows:

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Condition (1) Exposed energized parts on one side and ~~nonconducting surfaces on the opposite side of the workspace.~~ no energized or grounded parts on the other side of the working space, or exposed energized parts on both sides effectively guarded by suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered energized parts. Non-shielded insulated conductors shall be considered as exposed energized parts.

Condition (2) Exposed energized parts on one side and grounded parts ~~surfaces~~ on the other opposite side. Concrete, brick, plaster, or tile walls will be considered as grounded surfaces.

Condition (3) Exposed energized parts on both sides of the workspace (not guarded as provided in Condition 1) with the operator between.

EXCEPTIONS:

1. Workspace will not be required behind enclosed equipment such as dead-front switchboards or control assemblies, provided there are no renewable or adjustable parts; such as fuses, switches, etc., on the back, and provided all connections are accessible from ~~other~~ locations other than the back. Where rear access is required to work on the deenergized parts on the back of enclosed equipment, a minimum working space of 30 inches (762 mm) horizontally shall be provided. If work is to be performed on de-energized parts on the back of enclosed equipment, a minimum workspace of 30 inches is required.

2. Minimum depth of clear working space in front of electric equipment with a nominal voltage to ground above 25,000 volts may be the same as that for 25,000 volts under Conditions 1, 2 and 3 for installations built before April 16, 1981.

(Title 24, Part 3, Section 110-34(a).)

(b) Suitable space shall be provided and maintained about electrical equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear workspace shall not be less than 6 1/2 feet (1.98 m) high (measured vertically from the floor or platform), nor less than 3 feet (914 m) wide (measured parallel to the equipment). The depth shall be as required in subsection 2932(a). In all cases, the workspace shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

(Title 24, Part 3, Section 110-32.)

(c) If switches, cutouts, or other equipment operating at 600 volts, nominal, or less, are installed in a room or enclosure where there are exposed energized parts or exposed wiring operating at over 600 volts, nominal, the high-voltage equipment shall be effectively separated from the space occupied by the low-voltage equipment by a suitable partition, fence, or screen. However, switches or other equipment operating at 600 volts, nominal, or less, and serving only equipment within the high-voltage vault, room, or enclosure may be installed in the high-voltage enclosure, room, or vault if accessible to qualified persons only.

(d) The following requirements apply to the entrances to all buildings, rooms, or enclosures containing exposed energized parts or exposed conductors operating at over 600 volts, nominal:

(1) The entrances shall be kept locked unless they are under the observation of a qualified person at all times; and

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(2) Permanent and conspicuous warning signs shall be provided, reading substantially as follows: “DANGER – HIGH VOLTAGE – KEEP OUT.”

(e) Pipes or ducts that are foreign to the electrical installation and that require periodic maintenance or whose malfunction would endanger the operation of the electrical system may not be located in the vicinity of service equipment, metal-enclosed power switchgear, or industrial control assemblies. Protection shall be provided where necessary to avoid damage from condensation leaks and breaks in such foreign systems.

Note to subsection 2932(e): Piping and other facilities are not considered foreign if provided for fire protection of the electrical installation.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2933. Illumination.

Adequate illumination shall be provided for all working spaces about electrical equipment. Light outlets shall be so arranged that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment.

The points of control shall be so located that persons are prevented from contacting ~~not likely to come in contact with~~ any live part or moving part of the equipment while turning on the lights.

~~(Title 24, Part 3, Section 3-110-34(d).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

§2934. Elevation of Unguarded Live Parts.

Exposed energized parts above workspace and above areas where persons may normally walk or stand shall be maintained at elevations not less than that required by the following table:

Table 2934 – Elevation of Unguarded Live Parts above Workspace

NOMINAL VOLTAGE BETWEEN PHASES	ELEVATION	
	Feet	Meters
601-7500	8 feet – 6 inches <u>9.0¹</u>	<u>2.8¹</u>
7501-35kV, 000	<u>9.0 feet</u>	<u>2.8</u>
Over 35kV	9 feet + 0.37 inch/kV above 35kV	<u>2.8 + 9.5 mm/kV</u> <u>over 35kV</u>

¹ The minimum elevation may be 8.5 ft. (2.6 m) for installations built before [the effective date of these order].

~~(Title 24, Part 3, Section 110-34(e).)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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§2935. Installation of Electrical Equipment in an Outdoor Enclosure.

If exposed energized parts of electrical equipment are installed in an outdoor enclosure, the enclosure shall meet the requirements of Section 2812.1.

~~(Title 24, Part 3, Section 110 31(b).)~~ —

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(e), Health and Safety Code.~~

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Article 37. Provisions for Preventing Accidents Due to Proximity to Overhead Lines

§2946. Provisions for Preventing Accidents Due to Proximity to Overhead Lines.

(a) General. No person, firm, or corporation, or agent of same, shall require or permit any employee to perform any function in proximity to energized high-voltage lines; to enter upon any land, building, or other premises and there engage in any excavation, demolition, construction, repair, or other operation; or to erect, install, operate, or store in or upon such premises any tools, machinery, equipment, materials, or structures (including scaffolding, house moving, well drilling, pile driving, or hoisting equipment) unless and until danger from accidental contact with said high-voltage lines has been effectively guarded against.

(b) Clearances or Safeguards Required. Except where overhead electrical distribution and transmission lines have been de-energized and visibly grounded, the following provisions shall be met:

(1) Over Lines. The operation, erection, or handling of tools, machinery, apparatus, supplies, or materials, or any part thereof, over energized overhead high-voltage lines shall be prohibited.

EXCEPTION: 1: Aircraft over energized overhead high-voltage lines operating in conformance with:

(A) Applicable regulations administered by the Federal Aviation Administration, and/or

(B) Helicopter Operations, Article 35, Construction Safety Orders, California Administrative Code, Title 8.

EXCEPTION: 2: Tower cranes (Hammerhead) installed not closer than the minimum clearances set forth in Table 2, whereon the trolley or boom travel is controlled by limit switches which will prevent carrying a load over energized overhead high-voltage lines or within a horizontal distance closer than the minimum clearances set forth in Table 2.

(2) The operation, erection, handling, or transportation of tools, machinery, materials, structures, scaffolds, or the moving of any house or other building, or any other activity where any parts of the above or any part of an employee's body will come closer than the minimum clearances from energized overhead lines as set forth in Table 1 shall be prohibited.

EXCEPTION: Amusement rides or attractions shall not be located under or within 15 ft. (4.57 m) horizontally of conductors operating in excess of 600 volts.

Operation of boom-type equipment shall conform to the minimum clearances set forth in Table 2, except in transit where the boom is lowered and there is no load attached, in which case the distances specified in Table 1 shall apply.

TABLE 1

General Clearances Required from Energized Overhead High-Voltage Conductors

Nominal Voltage (Phase to Phase)	Minimum Required Clearance (Feet)
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600.....50,000	6
over 50,000...345,000	10
over 345,000...750,000	16
over 750,000...1,000,000	20

(3) Boom-type lifting or hoisting equipment. The erection, operation or dismantling of any boom-type lifting or hoisting equipment, or any part thereof, closer than the minimum clearances from energized overhead high-voltage lines set forth in Table 2 shall be prohibited.

(4) Storage. The storage of tools, machinery, equipment, supplies, materials, or apparatus under, by, or near energized overhead high-voltage lines is hereby expressly prohibited if at any time during such handling or other manipulation it is possible to bring such tools, machinery, equipment, supplies, materials, or apparatus, or any part thereof, closer than the minimum clearances from such lines as set forth in Table 1.

(c) The specified clearance shall not be reduced by movement due to any strains impressed (by attachments or otherwise) upon the structures supporting the overhead high-voltage line or upon any equipment, fixtures, or attachments thereon.

(d) Any overhead conductor shall be considered to be energized unless and until the person owning or operating such line verifies that the line is not energized, and the line is visibly grounded at the work site.

TABLE 2

Boom-type lifting or hoisting equipment clearances required from energized overhead high-voltage lines.

Nominal Voltage (Phase to Phase)	Minimum Required Clearance (Feet)
600..... 50,000	10
over 50,000.... 75,000	11
over 75,000... 125,000	13
over 125,000.. 175,000	15
over 175,000.. 250,000	17
over 250,000.. 370,000	21
over 370,000.. 550,000	27
over 550,000..1,000,000	42

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Subchapter 5. Electrical Safety Orders
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Article 39. Signs and Outline Lighting--Exceeding 600 Volts

§2974. Switches on Doors.

Doors or covers giving access to uninsulated parts of indoor signs or outline lighting exceeding 600 volts and accessible to other than qualified persons ~~the general public~~, shall either be provided with interlock switches which on the opening of the doors or covers disconnect the primary circuit, or shall be so fastened that the use of other than ordinary tools will be necessary to open them.

~~(Title 24, Part 3, Section 600-35.)~~

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code; ~~and Section 18943(c), Health and Safety Code.~~

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Article 41. Communications Systems

§2985.0. Scope.

This Article applies to radio and television receiving and transmitting equipment, including community antenna television and radio distribution systems, and similar central station systems over 600 volts nominal. These installations need not comply with the provisions of Article 3 through Article 86 of these High Voltage Electrical Safety Orders, except for Article 34.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2985.1. Equipment Location. Outdoor metal structures supporting antennas, as well as self-supporting antennas such as vertical rods or dipole structures, shall be located as far away from overhead conductors of electric light and power circuits of over 600 volts nominal as necessary to prevent the antenna or structure from falling into or making accidental contact with such circuits.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2985.2. Grounding.

(a) Masts and metal structures supporting antennas shall be permanently and effectively grounded without splice or connection in the grounding conductor.

(b) Transmitters shall be enclosed in a metal frame or grill or separated from the operating space by a barrier, all metallic parts of which are effectively connected to ground. All external metal handles and controls accessible to the operating personnel shall be effectively grounded. Unpowered equipment and enclosures are considered to be grounded where connected to an attached coaxial cable with an effectively grounded metallic shield.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 42. Induction and Dielectric Heating Equipment

§2987.0. Scope. This Article applies to induction and dielectric heating equipment and accessories for industrial and scientific applications, but not for medical or dental applications or for appliances.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2987.1. Guarding and Grounding.

(a) The converting apparatus (including the dc line) and high-frequency electric circuits (excluding the output circuits and remote-control circuits) shall be completely contained within enclosures of noncombustible material.

(b) All panel controls shall be of dead-front construction.

(c) Doors or detachable panels shall be employed for internal access. Where doors are used giving access to voltages over 600 volts ac or dc, either door locks shall be provided or interlocks shall be installed. Where doors are used giving access to voltages of over 1000 volts ac or dc, either mechanical lockouts with a disconnecting means to prevent access until circuit parts within the cubicle are deenergized, or both door interlocking and mechanical door locks, shall be provided. Detachable panels not normally used for access to such parts shall be fastened in a manner that will make them difficult to remove (for example, by requiring the use of tools).

(d) Warning labels or signs that read "DANGER – HIGH VOLTAGE – KEEP OUT" shall be attached to the equipment and shall be plainly visible where persons might contact energized parts when doors are opened or closed or when panels are removed from compartments containing over 600 volts ac or dc.

(e) Induction and dielectric heating equipment shall be protected as follows:

(1) Protective cages or adequate shielding shall be used to guard work applicators other than induction heating coils.

(2) Induction heating coils shall be protected by insulation or refractory materials or both.

(3) Interlock switches shall be used on all hinged access doors, sliding panels, or other such means of access to the applicator, unless the applicator is an induction heating coil at dc ground potential or operating at less than 150 volts ac.

(4) Interlock switches shall be connected in such a manner as to remove all power from the applicator when any one of the access doors or panels is open.

(f) A readily accessible disconnecting means shall be provided by which each heating equipment can be isolated from its supply circuit. The ampere rating of this disconnecting means may not be less than the nameplate current rating of the equipment. The supply circuit disconnecting means is permitted as a heating equipment disconnecting means where the circuit supplies only one piece of equipment.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

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Article 43. Integrated Electrical Systems

§2989.0. Scope.

This Article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An integrated electrical system as used in this section shall be a unitized segment of an industrial wiring system where all of the following conditions are met:

- (a) An orderly shutdown process minimizes employee hazard and equipment damage;
- (b) The conditions of maintenance and supervision ensure that only qualified persons will service the system; and
- (c) Effective safeguards are established and maintained.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.

§2989.1. Location of Overcurrent Devices in or on Premises.

Overcurrent devices that are critical to integrated electrical systems need not be readily accessible to employees if they are located with mounting heights to ensure security from operation by unqualified persons.

NOTE: Authority cited: Section 142.3, Labor Code. Reference: Section 142.3, Labor Code.